MONTHLY WEATHER REVIEW,

JULY, 1880.

(General Weather Service of the United States.)

WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

INTRODUCTION.

In preparing this REVIEW the following data, received up to August 14th, have been used, viz: the regular tri-daily weather charts, containing the data of simultaneous observations taken at 139 Signal Service stations and 15 Canadian stations, as telegraphed to this office; 148 monthly journals and 157 monthly means from the former, and 15 monthly means from the latter; reports from 24 Sunset stations; 209 monthly registers from Voluntary Observers; 37 monthly registers from United States Army Post Surgeons; Marine Records; International Simultaneous Observations; monthly reports from Voluntary Observers in, and the local Weather Service of, Missouri; reliable newspaper extracts; special reports.

BAROMETRIC PRESSURE.

The general distribution of the atmospheric pressure, as reduced to sea-level, for the month of July, 1880, over the United States and Canada is shown by isobaric lines on chart No. II. At a few out-lying stations the means are given in figures indicating English inches. The pressure is found to preserve much the same general distribution that it had during June, the regions of highest barometer being over the Southern States and Northern Pacific region, while the lowest barometer means are to be found in the Red river of the North and Sacramento valleys.

Departures from the Normal Values for July.—Like the preceding month the means for the present month, when compared with the average July means for the past eight years, show a remarkable uniformity. Along the immediate Atlantic and Texas coasts, from Iowa to Lower Michigan and in the Rocky Mountains the pressure is slightly below the normal, the greatest deviations being 0.05 of an inch at Charleston, Chicago and on the summit of Pike's Peak and 0.06 at Wood's Holl; elsewhere the means are slightly above normal, the largest excesses being 0.04 inch at Cairo, Cincinnati, Detroit and Albany and 0.06 at Duluth.

Barometric Ranges.—The local barometric ranges, as reduced to sea level, have been exceedingly small over the entire country. They are least along the southern border and increase very slowly northwards. It amounts to 0.20 of an inch at Key West and New Orleans, and 0.21 at Los Angeles, Cal.; to 0.49 at Norfolk, 0.32 at Cairo and 0.26 at San Francisco; to 0.52 at New York, 0.45 at Chicago, 0.54 at Cheyenne and 0.48 at Roseburg, Oregon; and along the northern border, to 0.57 at Eastport, Me., 0.70 at Alpena, Michigan., 0.68 at Marquette, 0.75 at Pembina, 0.62 at Virginia City, Mont., and 0.49 at Olympia, Wash. Ty.

Areas of High Barometer.—Eight areas of high barometer are described below. None of them present any very interesting features. The maximum pressures, as reduced to sea level, over the United States west of the Rocky Mountains, were 30.48 at Umatilla and 30.37 at Portland during the presence of high area No. IV, and, east of the Rocky Mountains, 30.30 at Denver during the presence of the same area, and 30.29 at Marquette during the presence of area No. VIII. The lowest temperatures of the month, in general, accompanied areas Nos. V and VIII.

This Paper is furnished by the Government of the United States, without charge, to the Co-operating Observers acting with the Signal Office in the collection of Simultaneous Reports.

No. I—appeared on the 2nd over the Lake region and moved slowly southeastward over the country east of the Mississippi, accompanied by clear or fair weather and light winds, until the morning of the 5th, when the highest barometer was off the North Carolina coast and low barometer area No. III over the Lake region.

No. II—followed in rear of low area No. III. On the 5th it covered the country west of the Mississippi, and having moved slowly eastward, accompanied by clear or fair weather from the Gulf coast to the Lakes, on the morning of the 8th covered the East Gulf and Atlantic States.

No. III—appeared over Quebec on the morning of the 11th in rear of low area No. V, and moving southward during that day and the 12th, had disappeared by night of the latter day to the south of Nova Scotia.

No. IV.—Except slight falls in the barometer during the presence of low areas Nos. III, IV and VI over the Western Plateau Districts, and a temporary rise in the barometer on the 8th over Oregon and Washington Territory, the pressure along the Pacific coast during the first ten days of July, deviated but little from the normal. On the 11th and 12th, however, a decided increase of pressure occurred over the Northern Pacific region and Northern Plateau District, (including Oregon, Washington Territory and Idaho) with the production of the following low temperatures, the minima of the month, at the stations named: Roseburg, Or., 45°; Red Bluff, Cal., 61°; Visalia, Cal., 56°; Boise City, Idaho, 41°; Salt Lake City, 45°, (with frost); Burkes, Ariz., 60°; Yuma, Ariz., 69°; Virginia City, Mont., 37°, and Helena, Mont., 38°. The maximum pressure (reduced to sea-level) of the month, over this region occurred as follows: On the 13th at Portland, Or. and Olympia, W. T., 30.34, or 0.33 and 0.36, respectively, above normal; at Winnemucca, Nev., 30.23 or 0.24; Umatilla, Or., 30.45 or 0.36; Salt Lake City, 30.22 or 0.29; 14th, Boise City, Idaho, 30.39 or 0.32, and Virginia City, Mont., 30.04 or 0.22. On the 15th the maximum pressures were transferred to the east of the Rocky Mountains and the barometer fell slightly over the Northern and Middle Plateau Districts: on this day the maximum pressure of the month was reported at Deadwood, Dak., (not reduced) 25.69 or 0.28 above normal; Cheyenne, 30.29 or 0.21; Denver, 30.30 or 0.20. The advance of this high barometer area was probably the remote cause of the heavy rains or "cloud bursts" which occurred during the afternoon of the 13th in the mountains in El Paso and neighboring counties in Colorado. A short account of the floods resulting therefrom will be found under the proper heading. On the 16th the maximum pressures covered the eastern slope of the Rocky Mountains and the northerly winds extended eastward to Michigan, Indiana and Tennessee without much change of temperature. During the 17th and 18th it divided into two small areas, the northern one moving into Canada and the southern one into the Lower Mississippi valley, which disappeared in their respective locations without producing any marked influence upon the weather east of the Mississippi.

No. V—appeared over the Northwest on the 19th, and during the 20th, 21st, 22nd and 23rd moved slowly southwards, central over the eastern slope of the Rocky Mountains, to Texas. The northerly or westerly winds in advance of this area, and in rear of low area No. VIII., extended south and eastward on the 19th to the Lower Missouri valley and Lake Michigan; on the 20th to northern Texas, Tennessee and the Middle Atlantic States; on the 21st to the interior of Texas and the Gulf States, producing the rains on the two latter dates, noticed under low area No. IX; and during the 22nd to the Gulf coast. Cautionary Signals were ordered in expectation of brisk winds, at Indianola on the midnight of the 22nd, and at Galveston on the morning of the 23rd, but were not justified; the wind at Indianola and Galveston only reaching NE., 14. The minimum temperatures of the month over the largest portion of the United States, from the Rocky Mountains eastward, occurred during the presence of this high barometer area. The following are the lowest recorded at the Signal Service stations in the several districts under its influence:—on the 19th, Pembina, Dak., 40°. 20th, Bismarck, 44°; La Crosse and Davenport, 52°; St. Louis, 59°. 21st, Grand Haven, 50°; Detroit, 52°; Indianapolis, 55°. 22nd, Denison, Tex., 57°; Erie, Penna., 57°; Augusta, Ga., 69°; Sandy Hook, N. J., 50°. 23rd, Ft. Gibson, Ind. Ty., 55°; Nashville, Tenn., 59°; New Orleans and Mobile, 71°; Charlotte, N. C. and Chincoteague, Va., 63°. 24th, Stockton, Tex., 58°; Laredo, Tex., 70°; Pensacola, Fla., 69°; Atlanta, Ga., 64°. The Missouri Weather Service reports as follows: "On the 21st and 22nd, the minimum (temperature) recorded in Lafayette Park (St. Louis) was 54°, and this figure has been exceeded but once in 45 years. In July, 1859, a minimum of 53° was observed by Engelmann." During the 25th and 26th the area moved eastward over the Southern States, followed by the easterly winds and rains in the Southwest, noticed under low area No. XI.

No. VI—spread gradually southeastward from Washington Territory and Montana on the 22nd, to Colorado on the 25th, when it joined the preceding area. It produced the following minimum temperatures of the month:—25th, Cheyenne, 49°; Denver, 54° and Pike's Peak, 28°. 26th, Santa Fé, 46°; Socorro, N. M., 59°, and Ft. Elliott, Tex., 49°.

No. VII.—During the night of the 25th the barometer rose rapidly along the coast of Oregon and Washington Territory, and on the 26th and 27th, fresh to brisk northwesterly winds extended south and eastward over the Plateau Districts and Montana, in rear of low area No. XII. On the 29th the maximum pressure was transferred to the Northern and Middle Plateau Districts, over which region it gradually dissipated. The following minimum temperatures of the month were recorded on the 28th:—Olympia, Or., 42°; Sacramento, Cal., 55°; Umatilla, Or., 52°, and Winnemucca, Nev., 41°.

No. VIII—appeared over Lake Superior on the 26th, and during the 27th, 28th, 29th, 30th and 31st moved very slowly southeastward, with its centre over the Lake region and Middle Atlantic States, to the Atlantic coast. The following minimum temperatures occurred in connection with this area:—on the 29th, Cleveland, Ohio, 52°; Pittsburg, Pa., 53°; Burlington, Vt., 49°; Atlantic City, N. J., 53°; and on the 30th, Wilmington, N. C., 65°; Ft. Whipple, Va., 58°, and Boston, Mass., 52°. Cautionary Signals were ordered along the North Carolina coast from Smithville to Cape Henry, which were justified from Smithville to Cape Hatteras, by a NE. wind of 26 miles at Cape Lookout.

Areas of Low Barometer.—Twelve areas of low barometer are described below, but, apart from the local thunder and hail-storms by which some of them were accompanied, are devoid of any special interest. Although the pressure along the Pacific coast during the early history of low areas Nos. III, IV, VI and XII experienced a decided decrease, it has not been possible to trace any of these areas back to the Pacific. With the exception of the centres of areas Nos. IX and XI, both of which, the latter during the whole and the former during the early portion of its history, were very poorly defined, the tracks of all the centres lie to the north of the 35th parallel.

No I.—This is the same area of low barometer that was noticed in the REVIEW for June as area No. XIII. During the 1st it remained central near to Dodge City, Kansas, at which station the pressure continued throughout the day about 0.20 in. below the normal. During the 2nd and 3rd it progressed in a NNE. course to north of Lake Superior at an average speed of about 20 miles per hour and disappeared thence into the British Possessions. During the 1st southerly winds generally prevailed over the United States from the Southwest to Illinois and thence to the Atlantic coast, the highest barometer being found off the South Atlantic coast, while over the northern portions of the Northwest and Upper Lake region northerly winds predominated. Numerous rains fell in the Lower Missouri valley and thence to Tennessee, the lower portions of the Lake region and Middle States. In the southern portions of the latter district the rains became heavy, with much thunder and lightning, as the day progressed, and during the night a centre of low barometer was formed which will be described as area No. II. A heavy thunder storm was also reported at New Orleans. On the 2nd the storm moved slowly northwards, central over Kansas. During the morning a very heavy thunder storm prevailed in the Lower Missouri valley: at Leavenworth a total rain-fall of 3.53 inches in 7 hours and a westerly wind of 38 miles per hour, damaging city property, were registered. At Mexico, Mo., 3.88 inches of rain fell during this day; at St. Louis, 2.11 inches of rain fell; at Yankton a severe dust-storm prevailed—wind NE. 43 miles. During the 1st and 2nd heavy hail accompanied the thunder storms in this section. On the 3rd the centre continued its northerly course over Nebraska and Minnesota; during the early morning a second thunder storm occurred at Leavenworth, but afterwards this area appeared to lose its stormy character.

No. II—appears to have slowly developed during the 1st in the trough of low barometer and rain-area which extended eastward from the area just described across the Lake region and Middle States. At 11 p. m. of the 1st a heavy thunder storm was prevailing over Virginia and thence to New Jersey with southwesterly winds, while northerly winds and rain were reported at Washington, Baltimore and Philadelphia. The rain-falls at Lynchburg, Norfolk and Cape Henry were, respectively, 1.80, 1.30 and 1.60 inches, while a strong gale from the SW. was reported at Chincoteague, Va. During the 2nd and 3rd this area passed in an ENE. course over the Atlantic, with its centre at some distance off the American coast, but caused cloudy or rainy weather during these days over New England, Nova Scotia and Cape Breton. No Cautionary Signals were ordered for this storm. The following maximum velocities (in miles per hour) were recorded: Cape Lookout, SW. 36; Cape Hatteras, SW. 34; Chincoteague, SW. 51; Delaware Breakwater, SW. 36, and Barnegat, W. 33. At noon of the 3rd Cautionary Signals were ordered on the coast of North Carolina, in anticipation of strong northerly winds, which were justified by the following velocities: Cape Hatteras, NE. 27; Kittyhawk, NE. 29 and Cape Henry, N. 27.

No. III.—After a temporary rise in the barometer, in rear of area No. I, over Colorado, Kansas and Nebraska, during the afternoon and night of the 2nd, the pressure decreased during the morning of the 3rd and on the afternoon of the latter date the centre of the present area may be located in Colorado to the southwest of Denver. During the 4th, 5th and 6th it moved in east-northeasterly course over the Lake region and down the St. Lawrence valley at an average and very uniform rate of about 30 miles per hour. During the afternoon and night of the 3rd, the centre passed eastward over Kansas and Nebraska as a very severe storm. At Cheyenne, Wy. Ter., a thunder storm, with heavy hail, ("stones large as pigeon eggs") began at 1.45 p. m. and ended at 2.25 p. m., during which the temperature of the air fell from 85° to 59°. At North Platte, Neb., the wind, at 6.40 p. m., blew with a steady velocity of 80 miles per hour from the NW, "with gusts of 100 miles velocity; rain fell in torrents with some small hail." At Dodge City, with a southerly wind, 1.26 in. rain fell in 2 hours. During the 4th and 5th the centre of depression moved to the St. Lawrence valley and the area of rains and local thunder storms spread itself over the entire eastern half of the United States, except along the Gulf, North Carolina and Virginia coasts. Heavy rain-falls were recorded on the 4th at Davenport, Ia., and on the 5th at Charleston, S. C., Charlotte, N. C., Baltimore, Md., Sandy Hook, N. J., and New York. Cautionary Signals were ordered up on the morning of the 5th from Sandy Hook, N. J., southward along the Atlantic coast to Chincoteague, Va., and on

the afternoon of the same date southward to Cape Lookout, N. C. They were all justified by the following maximum velocities: Cape Lookout, SW. 25; Cape Hatteras, NE. 27; Kitty Hawk, NE. 28; Cape Henry, N. 31, Chincoteague and Delaware Breakwater, S. 34; Cape May, S. 36; and Philadelphia, S. 25.

No. IV—appeared over northern Idaho and western Montana during the night of the 5th, and moved thence, during the 6th, 7th and 8th, at an average velocity of about 15 miles per hour, eastward over Montana, Dakota and Minnesota, disappearing on the 9th to the north of Lake Superior. It is highly probable, however, that area No. V may be a continuation of the same depression. On the 6th a thunder-storm was reported at Virginia City, Mont., and a NW. gale of 48 miles per hour at Fort Keogh, Mont., and during the 7th and 8th, threatening weather and rains extended over the Northwest and Upper Lake region. Occasional local rains or thunder-showers were also experienced on these days in the Southern States.

No. V—moved in a southeasterly direction from Quebec over the Gulf of St. Lawrence, during the 9th and 10th, and may be a continuation of the preceding area. It produced light rains in northern New England and the Canadian Maritime Provinces, and during its regime southerly winds and high temperatures prevailed over the interior of the Middle States and New England.

No. VI.—On the 9th the pressure over the Western Plateau, which, with the exception of a slight fall on the night of the 6th at Salt Lake City during the passage of area No. IV, had remained near the normal since the 3rd, experienced a decided fall. At 9 p. m. the barometer at Salt Lake City had fallen to 29.71 or 0.21 below the normal. Except light rains in western Texas, southern New Mexico, Oregon and Washington Territory, clear or fair weather prevailed every where west of the Mississippi. On the 10th the barometric fall spread rapidly eastward to the Missouri valley, and, by night, threatening or stormy weather prevailed from Colorado and Montana to the Lake region. On this day, (10th) the lowest barometers (reduced to zero and sea-level) of the month occurred at the following stations:—Virginia City, Mont., 11:00 a. m., 29.41, or 0.37 in. below normal; Salt Lake City, 4:20 p. m., 29.59, or 0.34 in.; Cheyenne, 3:51 p. m., 29.75, or 0.31 in.; Denver, 3:52 p. m., 29.74, or 0.35 in.; on the summit of Pike's Peak, 9:07 p. m., 30.02, or 0.27 in.; and North Platte, 3:36 p. m., 29.09, or 0.26 in. The hours of observation are Washington mean time. The maximum velocity of the wind for the month occurred on this day on the summit of Pike's Peak (SW. 44) at 10 p. m., and at Cheyenne (N. 32.) On the 11th, the storm was central in the Missouri valley, but was unattended by high winds, except a southerly wind of 40 miles at North Platte. Cautionary Signals were ordered for Duluth on the morning of the 11th, and remained displayed until the morning of the 12th, but were not justified. During the 12th and 13th, this area moved in a southeasterly direction from Lake Superior to off the coast of New England at an average rate of 35 miles per hour, attended by numerous local rains, occasional heavy, and brisk winds at one or two isolated stations (Rochester, N. Y., W. 31; Sandy Hook, N. J., NW. 28.) The observer at Paterson, N. J., reported a rain-fall of 1½ inch in eight minutes on the 13th. Excepting the signal at Duluth, already noticed, no signals were ordered for this area.

No. VII—appeared over Manitoba on the 14th, and moving at an average rate of 26 miles per hour, passed eastward, with its centre to the north of the Lake region and St. Lawsence valley during the 15th and 16th. Numerous rains, occasionally heavy, occurred on these days over the country east of the Mississippi, and brisk winds were recorded at a few stations in the Lake region and along the Atlantic coast from North Carolina to New Jersey. High winds were recorded at Alpena (W. 39) and Delaware Breakwater (SW. 42.) Cautionary Signals were ordered up, on the afternoon of the 16th, at Wood's Holl, Boston and Thatcher's Island, Mass., which were justified at Wood's Holl (SW. 28.)

No. VIII—developed over the Missouri valley region during the 18th, and on the same day moved by an ESE'ly path into Iowa and Missouri. On the morning of the 19th, the direction of its path had changed towards the NE. and during this day and the 20th its path continued in that direction over the Lake region and St. Lawrence valley. The average rate of translation was about 18 miles per hour. On the morning of the 18th, ere it was possible to locate the centre of depression, clear or fair weather prevailed over the entire Northwest, from Minnesota and Missouri to Montana. By afternoon the centre had become clearly defined and the winds at the stations in the extreme Northwest, circulated around a point to the west of Yankton. Very light rain had accompanied the NE. winds at Duluth, Minn., and Deadwood and Bismarck, Dak., and cloudy or threatening weather, with southerly winds, prevailed in the Red river valley, with heavy rain at Fort Sill. By the 11 p. m. report, however, rain had become general near the centre of depression and the rain-area extended from Texas to Wisconsin. On the 19th and 20th, as it moved towards the ENE. over the Lake region and St. Lawrence valley it produced brisk winds and rainy weather, with occasional heavy rain-falls, from those districts to the Ohio valley, Middle States and New England. Cautionary Signals were ordered up on the morning and afternoon of the 19th, at the ports along the Lake shores from Escanaba, Mich., to Buffalo, N. Y.; at 11 p. m., at ports along the New England coast from Eastport, Me., to Wood's Holl, Mass., and along the North Carolina and Virginia coasts, from Cape Hatteras to Chincoteague, and on the afternoon of the 20th at Delaware Breakwater and Cape May, N. J. They were justified, except at Port Huron, Erie and Eastport, by the following maxi-

mum velocities: Escanaba and Milwaukee, N. 27; Sandusky, W. 30; Rochester, W. 26; Thatcher's Island, SE. 34; Cape May, N. 25 and Kittyhawk, NW. 36.

No. IX.—As the preceding area moved over the northern portion of the country, southerly winds and high temperatures prevailed over the Southern States; as the low pressures moved eastward, the wind veered to cooler northerly in advance of high barometer area No. V, and a general rain set in, on the 20th, over the Southwest, which during the 21st gradually extended eastward to Tennessee, the Eastern Gulf and South Atlantic States. At 11 p. m. of the latter date a distinct circulation of the winds was observable in East Tennessee, Georgia and the Carolinas. On the morning of the 22nd the lowest pressure 29.93 or 0.08 below normal was observed at Charlotte, N. C., and during the day this area moved northeastwards off the coast as a somewhat severe storm. Cautionary Signals were ordered up along the North Carolina coast at noon, and along the New Jersey coast during the afternoon of the 22nd. They were all justified by the following maximum velocities: Cape Lookout, SW. 37; Cape Hatteras, SE. 33; Kittyhawk, SW. 40; Chincoteague, SW. 50; Delaware Breakwater, NW. 37; Cape May, NE. 28; Barnegat and Sandy Hook, N'ly, 30.

No. X—moved eastward over the British Possessions and Canada during the 25th and 26th and on the 27th covered New Brunswick and New England. The path of its centre was located too far north to allow it to appear on chart No. I. This area produced rainy and threatening weather from the Lake region to the Atlantic coast and on the night of the 25th, brisk southerly winds prevailed for a short time over the western end of Lake Erie and on Lake Huron. On the afternoon of the 26th Cautionary Signals were ordered along the Atlantic coast from Delaware Breakwater to Barnegat, N. J., and from Wood's Holl, Mass., to Portland, Me., which were justified by the following maximum velocities: Philadelphia, SW. 26 and Thatcher's Island, Mass., S. 34.

The two succeeding areas of low barometer, the one covering the extreme Southwest, namely, western Texas and the Rio Grande from the 26th to the 30th, the other the Northwest from the 28th to 30th, were apparently subsidiary to a large area of low pressure which covered portions of the Rocky Mountain region from the 25th to the end of the month. The tracks of these areas are not charted.

No. XI.—From the 26th to the end of the month the barometer over southern Texas and the Rio Grande valley remained slightly below the normal, while the highest pressures during these days were generally to be found over the Lake region. With this distribution of pressure easterly winds predominated over the Southwest and valley of the Rio Grande and cloudy or rainy weather, with heavy local rains, generally prevailed.

No. XII.—This area of low barometer may have originated in southern California on the 26th and have subsequently moved in a NE., direction over the Rocky Mountains to the Northwest, but its characteristics are not sufficiently well marked to allow a track of its path to be charted. On the evening of the 24th, the barometer at Visalia, Cal., fell to 29:64 or 0:12 below the normal, followed on the 25th by a sand storm from the NW. On the 25th and 26th, the lowest barometer, although only slightly below the normal, was transferred to the Western Plateau and Rocky Mountain Region. On the 25th,the observer at Winnemucca, Nev., reported "thunder storms on all sides during the day." During the 26th, 27th, 28th, and 29th, heavy storms of hail, sleet and rain occurred in the Rocky Mountains. On the 28th the lowest barometer was transferred to the Missouri valley, and on the 29th and 30th to the Red River of the North valley, and by the afternoon of the 31st the area of local rains and thunder showers had extended eastward to Illinois and Michigan. In Missouri the rains were quite heavy. Cautionary Signals were ordered for Duluth on the afternoon of the 28th and remained displayed until morning of the 30th, but were not justified.

INTERNATIONAL METEOROLOGY.

Three International charts, Nos. IV, V and VI, accompany the present Review. They are for the months of *June*, 1880 and *November*, 1878.

On chart No. IV will be found the probable course of the principal low barometer areas over the North Atlantic Ocean during the month of *June* 1880. As during the two preceding months (April and May, 1880) the Northern Atlantic during the month of June continued remarkably free from severe storms. The month opened with areas of low barometer, central over the Gulf of St. Lawrence (No. I chart IV,) near 38 N. 35 W. (No. II), and over the Bay of Biscay (No. III). Elsewhere over the region under consideration (namely the Atlantic Ocean, between the parallels of 35 and 55 N. and the adjacent coasts of America and Europe) high barometer generally prevailed, the regions of maximum pressure being to the south of the Banks of Newfoundland and to the north of Scotland. The low area on June 1st over mid-ocean is based upon the report of ship *British Commodore* and was probably of short duration. This vessel, in 40 N. 39 W. on June 1st reported barometer, 29.68 or 753.8, wind N. force 9, with rain-squalls. On the 2nd the area was apparently filling up and on the 3rd, so far as reports at present to hand indicate, had disappeared. In the mean time the low over the Gulf of St. Lawrence had passed to the north of Newfoundland; the one over the Bay of Biscay had moved toward the Netherlands, while a new area (No. IV on chart IV,) which apparently developed over North Carolina during the 1st, had moved northeastward and was on the morning of the 3rd central between Nova Scotia and the Bermudas—ship *Jumna* in

42 N. 63 W. reported barometer 29.89 or 759.2, wind NE. by E. force 8, heavy rain. During the 4th, 5th and 6th, it moved very slowly eastward to about 50 W. while thence eastward to the coast of Europe the Atlantic was covered by an area of very high pressures. On the morning of the latter date (6th) S. S. *Scythia*, in 42° N., 59° W., reported barometer 29.75 or 755.6, wind W. by N., force 4, while high barometers, from 30.45 or 773.4 to 30.60 or 777.2, were reported by several vessels between 40° and 50° N., and 20° and 40° W. Near the latter meridian high southeast winds were experienced. On the 7th the depression was apparently filling up, while the area of high barometer was moving slowly southward and diminishing in pressure. During the 8th the fall became more rapid over the eastern portion of the ocean and by the morning of the 9th a well defined area of low barometer (No. V) existed to the southwest of Ireland. This area having passed eastward the pressure, on the 10th, over the ocean remained near or slightly above the normal. On the night of the 10th, however, a rapid fall again set in over the eastern portion, and an area of quite low barometer (No. VI) moved northward during the 11th, 12th and 13th towards Iceland. S. S. *Britannic*, on the 11th, in 48° N., 29° W., reported barometer 29.74 or 755.4, wind N., force 4. During the 12th, 13th, 14th and 15th the area of low barometer already partly described in the June REVIEW, as low area No. V, moved very slowly eastward from the Gulf of St. Lawrence to the Banks of Newfoundland, the lowest barometer occurring at St. Johns, Newfoundland, at 9 p. m. of the latter date. The lowest barometer for the month at the Bermudas occurred on the 14th, the wind at Gibb's Hill Light continuing from WSW., force 5, from the 13th to the 16th, accompanied by thick, cloudy or hazy weather. On the 13th, S. S. *Pennsylvania*, in 40° N., 53° W., reported barometer 29.59 or 751.5, wind SW. force 6, rain; S. S. *Adriatic*, in 41° N., 53° W., 29.41 or 747.0, SW. force 7, cloudy, rough SW. sea-swell; and S. S. *Hibernian*, in 51° N., 37° W., 29.82 or 757.4, SE. by E. force 7, rain, moderate SE. swell. On the 14th, S. S. *Adriatic*, in 43° N., 46° W., 29.55 or 750.5, SSW. force 3. On the 15th, strong gales from the SSW. were experienced in advance of this area in about 40 W., which, with the exception of the occasional gales attending low area No. VI. on the 11th and 12th, may be considered as the first continued gales of the month. From the 16th to the 21st, this area moved slowly eastward across the Atlantic ocean, though not as a very severe storm. The following vessels report low pressures, and serve to indicate the position of the storm-centre on the different days:—S. S. *Pennsylvania*, 17th, 48° N., 27° W., 29.78 or 756.4, SSW. force 5, rain; 18th, 49° N., 21° W., 29.43 or 747.5, SE. by S. force 6, rain, heavy SE. by S. swell. S. S. *Celtic*, 19th, 51° N., 15° W., 29.57 or 751.0, ESE. force 3, fair; 20th, 50° N., 24° W., 29.56 or 750.8, NE. force 4, fair. S. S. *Braunschweig*, 20th, 49° N., 18° W., 29.47 or 748.5, S. force 2, fair. S. S. *Indiana*, 21st, 51° N., 16° W., 29.60 or 751.8, SW. force 2, fair. During the 22nd, and following days, it moved northeastwards over northern Europe, unaccompanied by high winds, except for a short time along the coasts of Norway and Sweden. Over the western portion of the Atlantic, during the 19th, 20th and 21st, northerly winds prevailed, with occasional heavy rain squalls. On the 22nd, the area of low barometer, described in the June Review as low area No. VII., was central over Nova Scotia. During the 23rd, 24th and 25th, this area moved eastward as shown on the present chart No. IV., in the track designated as No. VIII., and was encountered during these days by the following vessels:—S. S. *Nederland*, 23rd, 41° N., 59° W., 29.51 or 749.5, WSW. force 4, followed on the 24th by NW., 6, squally, high NW. sea-swell. S. S. *Celtic*, 24th, 43° N., 53° W., 29.48 or 748.8, NW. force 3, fair. S. S. *Braunschweig*, 25th, 43° N., 48° W., 29.56 or 750.8, SSW. force 3, fair. S. S. *Indiana*, 25th, 43° N., 42° W., 29.68 or 753.8, WSW. force 9, hard rain during the preceding 24 hours, high WSW. sea-swell; 26th, 41° N., 45° W., 29.80 or 756.9, WNW. force 9, hard rain during preceding 24 hours, high W'ly swell. By morning of the 26th, the centre had moved towards the NE., and, continuing in this direction, it passed to the north of the British Isles on the 28th, producing high southwesterly winds in the north of Ireland and Scotland. On the 27th it was encountered by the S. S. *Hibernian*, in 51° N., 34° W., 29.47 or 748.5, NW. by W. force 2, fair, long SW. swell, and by the S. S. *Britannic*, in 51° N., 24° W., 29.76 or 755.9, W. force 4, cloudy and drizzling. On the 23rd, an area of low barometer, No. IX., developed over the Eastern Atlantic—S. S. *Scythia*, 49° N., 22° W., 29.39 or 746.5, N. force 6, gloomy weather, with heavy showers—which from the 25th to the 28th moved eastward over southern Europe. On the 27th and 28th the area, already described in the June Review, as low area No. XI., and appearing on the present chart No. IV. as area No. X., moved slowly eastward, with its centre to the south of Newfoundland, but on the 29th it had apparently dissipated. Thence to the end of June, light winds and moderate pressures were reported.

Chart No. V shows, by isobaric and isothermal lines, the mean pressure and temperature, and, by small arrows, the prevailing direction of the wind, at 7:35 a. m., Washington mean time, over the Northern and portions of the Southern Hemispheres, for the month of November, 1878. The barometer observations have been corrected for temperature and reduced to sea-level. At stations lying outside the area included within the lines, and for those in the Southern Hemisphere, the means are shown by figures indicating the temperature in degrees, Fahrenheit, and the pressure in English inches. A comparison of the *distribution of atmospheric pressure* for the month of November, 1878, with that for the preceding month of October, shows the most marked changes to have occurred over the northeastern portion of the North Atlantic, where a very large increase of pressure is found, and in the Behrings Sea region, where there a corresponding decrease. The increase over Asia has not been as decided as during October, and, so far as the observations show, is found to be greatest over

the Upper Yenisei valley and the Punjab. A marked increase is also observable over the interior of the North American continent, while over the whole of central Europe a decided decrease has occurred. The *increase* over the various regions above referred to was as follows:—Over the North Atlantic, between 40° and 50° N., from 0.15 to 0.25 of an inch; between 50° and 60° N., from 0.20 in the ten degree square included by the meridians of 40° and 50° W. to 0.50 in the square included by the meridians of 20° and 30° W. Over the British Isles it was about 0.20 and at Stykkisholm, Iceland, 0.35. Over the southeastern part of Europe, about the Caspian sea region, it was 0.08. Over Asia it ranged from 0.10 in the Black sea and Bengal regions and at the mouth of the Amoor to 0.15 on the coast of China, 0.20 in the Punjab and 0.25 in the upper Yenisei valley. Over the interior of the North American continent it amounted to about 0.15 in Manitoba. The *decrease* over the Behring sea region amounted to 0.55 at St. Paul's Island, 0.39 at St. Michaels; over the Eastern Atlantic to 0.10 near the banks of Newfoundland and 0.05 at Godthaab, Greenland: and over central Europe to about 0.10. The area of absolute highest barometer (above 30.30 or 769.6, as reduced to sea-level) over the Northern Hemisphere, for the month, is found over the Asiatic continent, stretching in a southeasterly direction from the Sea of Aral, Barnaul and Yeniseisk to the coast of China, while smaller areas of over 30.10 or 764.5 are found over the Atlantic from 45° to 60° N, and 20° to 35° W, and over the southeastern and extreme western parts of the United States. The areas of absolute lowest barometer are found over Behring's sea, were the pressure averages about 29.25 or 743.0 and over the North sea, where it is about 29.65 or 753.1. The general direction of the *winds* during November, 1878, accords well with what might be expected from this distribution of pressure. Over the United States, except in the Rio Grande and Red River of the North valleys, where they were southerly; over the Atlantic, west of the 50th and east of the 25th meridian; over the extreme western portions of Europe; over Hindostan and along the eastern coast of Asia extending over Japan and Behring's sea, the directions were *northerly* or *westerly*; over the Atlantic between the 25th and 50th meridians, and over nearly the whole of Europe and northwestern Asia, *southerly*. The most notable winds of the month were probably the northerly winds over Western Europe and Hindostan, giving to the former region a temperature below the average, and to the latter a complete cessation (about the 12th of the month) to the monsoon rains.

On chart No. VI are traced the paths of twenty-eight of the principal storm-areas of the Northern Hemisphere for the month of November, 1878. Only one of them, (No. XXV, the track of which is doubtful) presented the characteristics of a tropical cyclone. Perhaps the two most striking pecularities of the storms, during this month, were (1) the recurving of the paths of several of them towards the west, as most plainly shown by areas Nos. I, VI, XI and XX, and (2) the heavy precipitation attending the various storms, during their northeasterly movement over the eastern portion of the United States and Central Europe.

TEMPERATURE OF THE AIR.

The mean temperature of the air for July, 1880, is shown by isotherms on chart No. II. The table of comparative temperatures given on the right hand side of this chart shows the temperature during July to have been *below the normal* over the whole of the United States, except along the Atlantic coast and at San Francisco. This, in connection with the average high mean temperatures recorded for the majority of districts east of the Rocky Mountains since the month of October, 1879, is very interesting.

Maximum Temperatures.—Maine: 95° at *Orono, 94° at Portland. *New Hampshire:* 100° at *Dunbarton, (62° on summit of Mt. Washington). *Vermont:* 99° at *Charlotte, 89° at Burlington. *Massachusetts:* 101° at Boston, 100° at *Somerset. *Rhode Island:* 88° at Newport. *Connecticut:* 97° at *Mystic, 88° at New London. *New York:* 96° at *Ardenia, 91° New York City, 85° at Buffalo. *New Jersey:* 99° at Atlantic City and *Moorestown. *Pennsylvania:* 96° at *Chambersburg, *Egypt and *Wellsboro, 95° at Philadelphia. *Delaware:* 97° at *Dover. *Maryland:* 99° at Baltimore. *District of Columbia:* 98° at Washington. *Virginia:* 102° at Norfolk. *West Virginia:* 89° at Morgantown. *North Carolina:* 104° at *Weldon, 98° at Wilmington. *South Carolina:* 97° at Charleston. *Georgia:* 100° at *Forsyth, 96° at Augusta. *Florida:* 100° at *Houston, 97° at Key West and Jacksonville. *Alabama:* 100° at Montgomery. *Mississippi:* 97° at Vicksburg. *Louisiana:* 101° at Point Pleasant, 96° at Shreveport. *Texas:* 108° at Eagle Pass, 103° at Laredo, Rio Grande and Edinburg, 102° at Stockton, 101° at Denison, Pilot Point, Concho and Castroville, 100° at Griffin, McKavett and Decatur. *Ohio:* 98° at *Jacksonburg, 97° at Columbus. *Kentucky:* 95° at Louisville. *Tennessee:* 95° at Memphis, Nashville and Chattanooga. *Arkansas:* 96° at *Mt. Ida, 95° at Little Rock. *Michigan:* 95° at *Niles, 93° at Detroit. *Indiana:* 97° at *Laconia, 93° at Indianapolis. *Illinois:* 100° at *Louisville, 96° at Springfield. *Missouri:* 98° at *Corning, 95° at St. Louis. *Kansas:* 103° at *Ft. Wallace and 95° at Leavenworth. *Wisconsin:* 95° at La Crosse. *Iowa:* 98° at Keokuk. *Nebraska:* 98° at *Genoa, 97° at North Platte and Omaha. *Indian Territory:* 100° at Ft. Gibson. *Minnesota:* 90° at *Minneapolis. *Dakota:* 98° at Ft. Keogh. *Colorado:* 95° at Denver. *New Mexico:* 107° at La Mesilla. *Wyoming:* 93° at Cheyenne. *Utah:* 95° at Salt Lake City. *Nevada:* 96° at Winnemucca. *Arizona:* 110° at Yuma and Burkes. *Idaho:* 98° at Boise City.

Montana: 86° at Virginia City. *California:* 108° at Red Bluff, 105° at Visalia. *Oregon:* 107° at Umatilla. *Washington Territory:* 94° Olympia.

Those marked with a star (*) are reported by U. S. Army Post Surgeons or Voluntary Observers.

Minimum Temperatures:—Maine: 47° at *Gardiner, 48° at Eastport and *Orono. *New Hampshire:* 31° on summit of Mt. Washington, 44° at *Dunbarton and Crafton. *Vermont:* 43° at *Woodstock, 49° at Burlington. *Massachusetts:* 48° at *South Lee; 52° at Boston. *Rhode Island:* 58° at Newport. *Connecticut:* 55° at New London. *New York:* 43° at *Waterburg, 52° at Rochester, 59° at New York City. *New Jersey:* 53° at Atlantic City and *Newark. *Pennsylvania:* 42° at *Franklin, 53° at Pittsburg. *Delaware:* 64° at *Dover. *Maryland:* 45° at *Cumberland, 62° at Baltimore. *District of Columbia:* 59° at Washington. *Virginia:* 52° at Wytheville. *West Virginia:* 53° at Morgantown. *North Carolina:* 52° at *Highland, 63° at Charlotte. *South Carolina:* 71° at Charleston. *Georgia:* 64° at Atlanta. *Florida:* 69° at Pensacola and Punta Rassa. *Alabama:* 69° at Montgomery. *Mississippi:* 64° at Vicksburg. *Louisiana:* 64° at Shreveport. *Texas:* 43° at Fredericksburg, 49° at Ft. Elliott, 57° at Pilot Point. *Ohio:* 52° at Cleveland. *Kentucky:* 60° at Louisville. *Tennessee:* 59° at Nashville. *Arkansas:* 59° at *Mt. Ida, 62° at Little Rock. *Michigan:* 43° at Marquette, 52° at Detroit. *Indiana:* 52° at *Spiceland, 55° at Indianapolis. *Illinois:* 46° at *Marengo, 55° at Springfield. *Missouri:* 49° at *Pierce City, 59° at St. Louis. *Kansas:* 53° at *Yates Centre and *Wellington, 56° at Leavenworth. *Wisconsin:* 49° at *Neillsville, 52° at La Crosse. *Iowa:* 48° at *Nora Springs, 52° at Davenport. *Nebraska:* 54° at Omaha. *Indian Territory:* 55° at Ft. Gibson. *Minnesota:* 57° at *Minneapolis. *Dakota:* 42° at Deadwood. *Colorado:* (28° on summit of Pike's Peak,) 32° at *Summit, 49° at *Hermosa. *New Mexico:* 46° at Santa Fé. *Wyoming:* 49° at Cheyenne. *Utah:* 45° at Salt Lake City. *Nevada:* 41° at Winnemucca. *Arizona:* 60° at Burkes. *Idaho:* 41° at Boise City. *Montana:* 37° at Virginia City. *California:* 51° at San Francisco, 55° at Sacramento. *Oregon:* 45° at Roseburg. *Washington Territory:* 42° at Olympia.

Those marked with a star (*) are reported by U. S. Army Post Surgeons or Voluntary Observers.

Ranges of Temperature.—The monthly ranges will appear from an examination of the above minimum and maximum temperatures. The greatest *daily ranges* vary as follows: New England, from 18° at Wood's Holl to 32° at Eastport; Middle Atlantic States, 19° at Cape May to 24° at Albany and 29° at Norfolk; South Atlantic States, 15° at Cape Lookout to 25° at Jacksonville and 26° at Wilmington; Eastern Gulf States, 15° at New Orleans to 26° at Montgomery; Western Gulf States, 16° at Galveston to 28° at Corsicana; Ohio valley and Tennessee, 21° at Cairo to 32° at Pittsburg; Lower Lakes, 19° at Erie to 28° at Cleveland; Upper Lakes, 20° at Chicago to 36° at Duluth; Upper Mississippi valley, 23° at La Crosse to 29° at Des Moines; Red river of the North valley, 34° at Breckenridge to 38° at Pembina; Missouri valley, 25° at Omaha to 37° at Fort Stevenson and 40° at Bismarck; Texas, 24° at San Antonio to 28° at Rio Grande City and 34° at Fort Elliott; Eastern Rocky Mountain Slope, 26° at Fort Sill to 36° at North Platte and 48° at Fort Keogh; Rocky Mountains, 23° on summit of Pike's Peak to 33° at Virginia City and 40° at Cheyenne; Western Plateau, 33° at Salt Lake City, to 39° at Boise City and 46° at Winnemucca; California, 20° at San Francisco to 35° at Red Bluff and 40° at Visalia.

Ice was reported on the summit of Mount Washington, 29th; at Summit, Rio Grande Co., Col., 11th and 30th.

Frost.—Utah.—Salt Lake City, 12th. *Colorado.*—Summit of Pike's Peak, 6th, 17th, 18th, 26th, 27th, 30th, and 31st. At Summit, Rio Grande Co., frequent. *New Hampshire.*—Summit of Mount Washington, 29th.

PRECIPITATION.

The general distribution of rain-fall, for July, 1880, is shown on chart No. III, as accurately as possible, from about 500 reports. The table on this chart shows the average precipitation for the several districts compared with the normal values. The rain-fall has been above the normal along the Gulf and Atlantic coasts, in the St. Lawrence valley and Upper Lake region, about normal over the Lower Lakes and Lower Missouri valley and below normal elsewhere. The characteristic features of the rains during the month have been (1) their local nature, (2) their short duration and (3) their copiousness. Thus, in Kansas and Missouri, while heavy rains fell during the first few days of the month, during the latter part of the month both states suffered from drought. In the paragraph on Specially Heavy Rains, some remarkable records will be found, among which may be noted a heavy rain-fall of 1¼ inch in 8 minutes at Paterson, N. J.

Special Heavy Rains.—1st, Independence, Ia., 1.75 inches in 45 minutes; St. Louis, 2.07 in. 1st and 2nd, College Hill, Cincinnati, Ohio, 3.25. 2nd, Laconia, Ind., 2.74 in; Mexico, Mo., 3.88. 2nd and 3rd, McMinnville, Tenn, 3.98; Strafford, Vt., 3.50; Leavenworth, 5.11; Mystic, Conn., 2.95 in; Woodstock, N. H., 4.00 in. 3rd, Socorro, N. M., 1.14 in.; Rowe, Mass., 1.80 in. in 2 hours. 4th, Ft. Sill, Ind. Ty., 2.31. 5th, Fallsington, Pa., 5.38; Sandy Springs, Md., 5.00 in. in 2 hours and 30 minutes; White Plains, N. Y., 1.80 in. in 6 hours; Somerville, N. J., 4.34 in. 5th and 6th, Trenton, N. J., 4.13 in.; Princeton, N. J., 4.44 in.; Trenton, N. J., 6.72 in.; New Brunswick, N. J., 2.53 in.; Linden, N. J., 2.34 in.; Paterson, N. J., 2.22 in.; Somerville, N. J., 2.08 in. 6th, Mesquite, Tex., 2.00 in.; Ft. Randall, Dak., 2.50 in. 7th, Omaha, Neb., 2.42 in.; Clear Creek, Neb., 2.50 in. in 20

minutes and 4.50 in. in 1 hour and 27 minutes. 8th, Des Moines, Ia., 4.00 in. 9th, Little Mountain, Ohio, 2.75 in. 10th, Independence, Ia., 4.50 in. 10th and 11th, Columbus, Ohio, 3.10 in.; Ruggles, Ohio, 4.00 in. 12th, Flushing, N. Y., 4.15 in. in 2 hours. 12th and 13th, Clinton, Mass., 2.64 in.; Willetts Point, N. Y., 3.34 in.. 13th, Point Pleasant, La., 1.03 in. in 1 hour. Pembina, 2.00 in. in 30 minutes; Paterson, N. J., 1.50 in. in 8 minutes. 14th, Silver City, N. M., 1.79 in. 14th and 15th, Shreveport, La., 2.50 in. 15th, Mendon, Mass., 2.25 in.; Eagle Pass, Tex., 1.84 in. 16th, Point Pleasant, La., 1.00 in. in 35 minutes. 17th, Belmont, N. H., 2.60 in. 17th and 18th, New Ulm, Tex., 2.50 in. 18th and 19th, New Corydon, Ind., 2.69 in. 19th, San Antonio, Tex., 1.76 in.; St. Augustine, Fla., 1.16 in. in 1 hour; Chambersburg, Pa., 2.59 in. 19th and 20th, Trenton, N. J., 3.24 in.; Ft. Wallace, Kan., 3.90 in.; Clarksville, Tex., 4 in. 20th, Fallsington, Pa., 2.53 in.; Antrim, N. H., 2.50 in.; Westborough, Mass., 2.36 in.; Blooming Grove, Pa., 2.60 in.; Sandy Springs, Md., 2.04 in. in 4 hours; Point Pleasant, La., 1.30 in. in 56 minutes; Ft. Union, N. M., 2.62 in. Ashland, N. H., 2.10 in.; Mesquite, Tex., 3.00 in.; Henrietta, Tex., 1.55 in.; Baltimore, Md., 3.49 in. 20th and 21st, Dover, Del., 2.50 in.; Clinton, Mass., 2.56 in. 21st, Cape Hatteras, 3.17 in.; Mesquite, Tex., 3.00 in.; Melissa, Tex., 2 in. 21st and 22nd, Linden, N. J., 3.46 in.; Ellsworth, N. C., 5 in.; Lenoir, N. C., 2.30 in.; 22nd, Fallingston, Pa., 2.67 in.; Princeton, N. J., 2.70 in.; Trenton, N. J., 3.28 in.; New Brunswick, N. J., 2.22 in.; Barnegat, N. J., 2.28 in.; White Plains, N. Y., 3 in.; Point Pleasant, La., 2.01 in. in 5 hours; Ft. Barrancas, Fla., 3.75 in.; McKavett, Tex., 4 in. 22nd and 23rd, Kitty Hawk, N. C., 4.78 in.; Augusta, Ga., 3.47 in.; Cape Lookout, 5.82 in.; Cape Hatteras, 3.52 in.; Ft. Adams, R. I., 2.44 in. 23rd, Eagle Pass, Tex., 2.08 in.; Pikes Peak, 2.39 in.; Cedar Keys, 2.43 in.; New Bedford, Mass., 2.45 in.; St. Augustine, Fla., 1.80 in. in 1 hour; Ft. Union, N. M., 2.25 in. 23rd and 24th, Fall River, Mass., 2.55 in. 24th, Wilmington, N. C., 3.50 in. 24th and 25th, Ellsworth, N. C., 3 in. 25th, Stockton, Tex., 2.48 in.; Brownsville, Tex., 2.80 in. 26th, Eagle Pass, Tex., 1.58 in.; St. Augustine, Fla., 2.32 in. 26th and 27th, New Corydon, Ind., 4.47 in. 27th, Mason, Tex., 1.15 in.; Castroville, Tex., 2.17 in.; Fredericksburg, Tex., 2.10 in.; Wilmington, N. C., 2.50 in. 27th and 28th, Cedar Keys, 3.88 in.; New Ulm, Tex., 4.50 in. 28th, Point Pleasant, La., 3.02 in.; Shreveport, La., 4.52 in.; Castroville, Tex., 1.76 in.; Ft. Barrancas, Fla., 1.38 in. in 1 hour and 40 minutes. 28th and 29th, Fayette, Miss., 2.70 in. 29th, Point Pleasant, La., 2.31 in.; Ft. Wallace, Kan., 3.84 in.; Mason, Tex., 1.69 in.; Pilot Point, Tex., 1.08 in.; Fredericksburg, Tex., 1.30 in. 30th, Dennison, Tex., 2.33 in.; St. Augustine, Fla., 2.33 in. 31st, Oregon, Mo., 1.81 in.; Greenfield, Mo., 1.90 in.

Largest Monthly Rain-falls.—Freehold, N. J., 15.12 in.; Wilmington, N. C., 12.84 in.; Fort Wallace, Kan., 12.59 in.; Fallsington, Penn., 12.51 in.; Wellsboro', Penn., 12.30 in.; Paterson, N. J., 12.06 in.; Point Pleasant, La., 11.33 in.; New Orleans, La., 11.22 in.; Princeton, N. J., 11.13 in.; St. Augustine, Fla., 11.09 in.; Ft. Barrancas, Fla., 11.03 in.; Shreveport, La., 10.97 in.; Elsworth, N. C., 10.88 in.; Independence, Ia., 10.40 in.; Concho, Tex., 10.26 in.; Austin, Tenn., 10.13 in.; Flushing, N. Y., 10.10 in.; White Plains, N. Y., 10.00 in.; Kittyhawk, N. C., 9.94 in.; New Corydon, Ind., 9.13 in.; Cedar Keys, Fla., 9.10 in.; Cape Hatteras, N. C., 9.06 in.; Somerville, N. J., 8.86 in.; New Ulm, Tex., 8.75 in.; Willets Point, N. Y., 8.71 in.; Vineland, N. J., 8.64 in.; Trenton, N. J., 8.57 in.; Sandy Springs, Md., 8.41 in.; Mesquite, Tex., 8.38 in.; Clinton, Mass., 8.12 in.; Fort Union, N. Mex., 7.98 in.; Norfolk, Va., 7.84 in.; Woodstock, N. H., 7.83 in.; Castroville, Tex., 7.74 in.; Pike's Peak, Col., 6.69 in.; Stockton, Tex., 7.27 in.; Clarksville Tex., 6.50 in.; Camp Apache, Ariz., 5.83 in.; Camp Grant, Ariz., 5.63 in.

Smallest Monthly Rain-falls.—Point San Jose, San Gorgonio, Princeton, San Francisco and Red Bluff, Cal., Ft. McDermitt, and Winnemucca, Nev., and Coalville, Utah, none; Los Angeles, Sacramento, and Visalia, Cal., Yuma, Ariz., Battle Mountain, and Terrace, Nev., trace; Roseburg, Oreg., 0.01 in.; Boise City, Idaho, and Golconda, Nev., 0.02 in.; Burkes, Ariz., 0.04 in.; Albany, Oreg., and Palisade, Nev., 0.05 in.; Browns, Nev., and San Diego, 0.09 in.; Campo, Cal., 0.12 in.; Carson City, Nev., 0.13 in.; Truckee, Cal., 0.16 in.; Phoenix, Ariz., 0.18 in.; Halleck, Nev., 0.24 in.; Eola, Or., 0.25 in.; Ft. Douglas, Utah, 0.30 in.; Umatilla, Or., 0.48 in.; Olympia, W. T., 0.52 in.; Portland, Or., 0.59 in.; Humboldt Wells, Nev., 0.60 in.; Salt Lake City, 0.80 in.

Rainy Days.—The number of days on which rain or snow has fallen, varies as follows: New England, 11 to 19; Middle Atlantic States, 10 to 18; South Atlantic States, 9 to 19; Eastern Gulf States, 11 to 21; Western Gulf States, 7 to 14; Ohio valley and Tennessee, 6 to 16; Lower Lake region, 10 to 19; Upper Lake region, 13 to 21; Upper Mississippi valley, 8 to 14; Lower Missouri valley, 9 to 12; Red River of the North valley, 8 to 11; Eastern Rocky Mountain Slope, 7 to 11; Texas, 4 to 16; Rocky Mountains, 7 to 24; Middle Plateau, 0 to 4; California, 0 to 2; Oregon, 3 to 9.

Cloudy Days.—The number varies in New England from 9 to 14; Middle Atlantic States, 5 to 12; South Atlantic States, 5 to 16; Eastern Gulf States, 2 to 12; Western Gulf States, 2 to 10; Ohio valley and Tennessee, 3 to 10; Lower Lake region, 3 to 8; Upper Lake region, 1 to 9; Upper Mississippi valley, 2 to 8; Lower Missouri valley, 2 to 5; Red River of the North valley, 2 to 3; Eastern Rocky Mountain Slope, 3 to 9; Texas 3 to 16; Rocky Mountains, 2 to 10; Middle Plateau, 1 to 4; California, 0 to 3.

Hail:—Hail fell frequently throughout the month and the following extracts from observers' reports and newspapers attest the severity of some of these local storms. Big Creek, Mo., 1st,

severe hail storm, crops destroyed and many geese and pigs killed. Wright City, Mo., 1st, several buildings badly damaged by hail, stones eight inches in circumference. Springfield, Ill., 1st, very violent hail-storm, stones two inches in diameter and from two to three inches in length. Dongola, Union Co., Ill., 1st, several hundred acres of corn and wheat destroyed by hail, stones as large as hen's eggs. Harrisonville, Mo., 2nd, great damage to crops by hail. Cheyenne, 3rd, heavy hail-storm destroying much window glass. Statesville, N. C., 14th, six miles east of station, violent hail-storm doing great damage to corn and cotton crops. Potter county, Penn., 16th, 6.30 a. m., hail-stones 4 to 6 inches in circumference; all crops along track of storm were entirely destroyed; track one mile wide and from three to five miles in length; course southwest to northeast. Massebesic, N. H., 16th, hail-stones covered the ground. Manchester, N. H., 16th, hail-stones one inch in diameter. Genoa, Neb., 17th, hail stones 1 to 1½ inch in diameter covered with spikes ¾ inch in length; all crops in path of storm entirely destroyed and stock severely bruised. Rochester, N. Y., 18th, hail-stones one inch in diameter; great damage was caused to growing crops near Spenceport, Lewiston and Gasport. Trenton, N. J., 20th, hail-stones size of peas. Hudson, Mich., 23rd, great damage to corn and oat crops by hail; many farm houses had windows demolished; birds and fowls killed; course southwest to northeast; track one-half to one mile wide. Medina, Mich., 23rd, very violent; hail-stones four inches in circumference. Waupaca, Wis., 26th, during afternoon, terrible hail-storm passed from southwest to northeast; stones covered the earth several inches deep and were from the size of walnuts to two inches in diameter. One measured nine and a-half inches in circumference. All corn and green crops were cut to the ground; large limbs of trees were broken off and some animals reported killed; track of storm about two miles wide. Steven's Point, Wis., 26th, violent hail-storm, stones six to ten inches in circumference and from four to eight inches deep on the ground, killing turkeys, geese, lambs, sheep and thousands of prairie chickens. Shingles were entirely cleaned from the roofs of many buildings and over 100 farms were entirely divested of all green crops. Leaves were cut from the forest trees leaving them as bare as in winter. Track of storm about 4 miles wide and from 8 to 10 miles long. Loss estimated at $100,000. Coalville, Utah, 27th, heaviest storm for years; ground white with stones. Buzzard's Bay, Mass., 29th, 5 p. m., very violent hail-storm; stones two inches deep on the ground and many of them ¾ inch in diameter. Hail-stones as large as filberts fell in Foxborough and other portions of Norfolk county; at Monument Beach corn-fields were destroyed and at Aggawam the ground was covered to a depth of three inches, many of the stones being over an inch in diameter. Fort Adams, R. I., 29th, violent hail-storm. Hail was also reported at Wellsboro, Pa., on the 16th and at Norwalk, Ohio, on the 23rd.

Snow—fell on the summit of Pike's Peak, 9th, 10th, 13th to 17th, 19th, 20th, 21st, 23rd to 26th, 28th. On the summit of Mt. Washington, 29th.

Floods.—Umatilla, Or., 1st, navigation suspended, because of high water in river; portages submerged at the Dalles, Walla Walla and Umatilla, but no serious damage as yet. Portland, Or., 1st, considerable portion of city inundated. Sandy Springs, Md., 5th, fields badly washed, mill dams and fences carried away. Van Metre, Ia., 7th, 8th, railroad train submerged three feet, and forty rods of embankment washed away. Winterset, Ia., 7th, 8th, crops and fields badly washed, and all railroad communication obstructed. Hannibal, Mo., 7th, 8th, $200,000 worth of wheat, and $100,000 worth of fences, barns, dwellings and farming implements, destroyed by breaks in the Sny levee on the Illinois side of the Mississippi river. Des Moines, Ia., 8th, cellars filled with water, streets and culverts badly washed. About eight miles south of station damage more severe; portion of railroad track and several bridges, washed away, considerable damage to buildings. Cleveland, 9th, streets and culverts badly washed, street-car lines submerged, cellars flooded and sidewalks carried away. Champaign, Ill., 9th, immense damage to growing and harvested crops; highways badly washed, and bridges carried away. Rowe, Mass., 10th, highways and railroad tracks badly washed, and bridges carried away. La Crosse, Wis., 10th, much damage to wheat and oats. Waterloo, Iowa, 10th, 11th, 10 p. m. to 3:20 a. m.; severe rain-storm destroying crops and washing out roads and bridges; three children were drowned by the overflowing of a "run" previously dry. Independence, Iowa, 10th, 11th, water upon the floor of the opera house and Presbyterian church three feet deep; great amount of damage to all kinds of property in vicinity. Pueblo, Col., 13th, very heavy rains, creeks badly swollen; two families camping out near by were washed away and drowned. Colorado Springs, 13th, immense damage in El Paso and surrounding counties; several bridges on the Denver and Rio Grande Railroad washed out, and 2,700 feet of railroad between this station and Manitau carried away; immense damage to growing crops. Umatilla, Or., 18th, a cloud burst up west Butter Creek, washed away trees, fences and bridges, and caused considerable damage to other property. Baltimore, 20th, damage to city by flooding, $50,000. Colorado Springs, Col., 23rd, very heavy rains and washouts; three railroad bridges washed away. San Antonio, Tex., 28th, railroad tracks badly washed, all communication obstructed. Stockton, Tex., 28th, 120,000 bushels of wheat, oats and barley destroyed by heavy rains. Shreveport, La., 28th, great destruction to cotton crop, Carlisle, Pa., 29th, terrific rain storm, water ran four feet deep in some of the roads, flooding many houses and causing great damage to crops.

Droughts.—New York: Waterburg, 1st to 10th, drought, severe. *Massachusetts:* Westborough, 1st to 12th, great need of rain. *Illinois:* Augusta, 20th to 30th, very dry. *Kansas:* Wellington, 21st to 31st, all vegitation suffering. *Georgia:* Gainesville, 31st, crops suffering very severely.

Missouri: Louisiana, 31st, cisterns generally empty and creeks dried up; Glasgow, 31st, many springs stopped running. "The Missouri Weather Service" reports drought very severe in the north, northeast and central sections of the State, vegitation damaged.

Rainfall during June, received too late to be used in June Review.—Arizona: Whipple Barracks, Ft. McDowell and Ft. Mojave, none; Ft. Lowell, 0.20 inch.; Ft. Bowie, 1.50; Ft. Verde, 0.14; Ft. Apache, 0.53; Camp Thomas, 0.55. *California:* Benecia Barracks, Angel Island, Presidio, Oakland and Poway, none. Ft. Gaston, 0.12. *Colorado:* Ft. Lyons, 0.55; Ft. Collins, 0.86. *Dakota:* Ft. Stevenson, 4.10; Ft. Sisseton; 6.00; Ft. Sully, 2.35; Ft. Totten, 3.17. *Idaho:* Ft. Lapwai, 1.15; Lewiston, 1.07. *Montana:* Ft. Benton, 4.50; Ft. Shaw, 2.39; Ft. Ellis, 8.01; Ft. Keogh, 0.51; Ft. Logan, 0.49; Ft. Assinniboine, 2.44. *Oregon:* Ft. Stevens, 3.15; Ft. Klamath, 0.38. *Washington Territory:* Ft. Canby, 2.58; Ft. Townsend, 0.92; Dayton, 1.00; Neah Bay, 1.27; Bainbridge Island, 2.21.

RELATIVE HUMIDITY.

The percentage of mean relative humidity for the month ranges as follows: New England, from 62 to 87; Middle Atlantic States, 59 to 88; South Atlantic States, 62 to 80; Eastern Gulf States, 65 to 73; Western Gulf States, 64 to 76; Ohio valley and Tennessee, 60 to 76; Lower Lake region, 61 to 71; Upper Lake region, 67 to 77; Upper Mississippi valley, 61 to 69; Missouri valley, 59 to 62; Red River of the North valley, 69 to 73; Eastern Rocky Mountain Slope, 54 to 73; Texas, 62 to 77; Middle Plateau, 17 to 33; California, 31 to 82; Oregon, 57 to 69. *High stations* report the following averages not corrected for altitude: Pike's Peak, 71; Mt. Washington, 82; Virginia City, 37; Denver, 47; Santa Fe, 40.

WINDS.

The *prevailing directions of the wind* during July, 1880, is shown by arrows, flying with the wind, on chart No. II. To the east of the Rocky Mountains the predominating winds have been *southerly*, with an easterly trend over Texas, and a westerly one from the Eastern Gulf and Atlantic coasts to the Lake region. At the Rocky Mountain stations, over the Middle and Northern Plateau Districts and North Pacific region, the directions are *northwesterly*. On the summit of Mt. Washington, N. H., the direction is NW, and the continuous record of the wind velocity shows a total monthly movement of 17,943 miles; the maximum hourly velocity during the month was NW. 72 miles on the 10th, The same data for the summit of Pike's Peak is SW., 8,493 miles, and SW., 44 miles on the 10th. Maximum velocities exceeding 50 miles per hour were recorded at Umatilla (SW., 52, on the 18th); North Platte, (NW., 80, on the 3rd) and Chincoteague, (SW., 53, on the 1st.)

Total Movements of the Air.—The following are the *largest* total movements in the variious districts: Mt. Washington, (summit of) 17,943 miles; Cape Lookout, 10,964; North Platte, 9,643; Rio Grande City, Tex., 9,594; San Francisco, 9,186; Cape Hatteras, 8,904; Chincoteague, Va., 8,768; Indianola, 8,554; Delaware Breakwater, 8,510; Pike's Peak, (summit of) 8,439; Umatilla, Or., 8,392; Portsmouth, N. C., 8,365; Wood's Holl, 7,892; Thatcher's Island, 7,822. The *smallest* are: Lynchburg, 1,364 miles; La Mesilla, N. M., 1,440; Augusta, 2,013; Silver City, N. M., 2,057; Visalia, Cal., 2,378; Nashville, 2,342; Des Moines, Iowa, 2,406; Morgantown, 2,543; Springfield, Mass., 2,777; Socorro, N. M., 2,872; Knoxville, 2,940; Cincinnati, 2,997.

Local Storms.—Jacksonburg, Ohio, 2nd, 4 p. m., small tornado passed two miles south of village in a direction from SW. to NE., width of track about 60 rods. "There were two inverted cones of vapor, one reaching from the clouds nearly to the earth and then joining the apex of the lower one extending upward from the ground. During its passage it was accompanied by a noise similar to the violent escape of steam. Sheaves of wheat and many other objects were drawn upwards and quickly lost sight of. The ground over which the storm passed appeared as if drenched by a flood." Cairo, Ill., 2nd, 1:35 p. m., very heavy wind-storm, lasting about 15 minutes, unroofing buildings and blowing down fences and trees. Chattanooga, Tenn., 2nd, severe wind-storm, blowing down trees and fences; 3rd, 6:25 to 6:47 p. m., severe NW. storm, during which the wind reached a velocity of 60 miles per hour for a period of 5 minutes, and averaged 48 miles for 15 minutes, unroofing buildings and uprooting trees, damage $1,500. Reports from Walker and Catoosa counties, in northern Georgia, show exceedingly violent storms on this date, and great loss to agricultural interests. Columbia, S. C., 5th, violent tornado, unroofing buildings, uprooting trees and destroying crops and fences. Clear Creek, Neb., 7th, 4:30 p. m., violent tornado approached from the southwest, passing about 3 miles north of station; 15 to 20 buildings were destroyed and great damage caused to crops. A large quantity of water was reported to have been taken out of Platte river as the storm crossed it. Hanover, N. H., 16th, afternoon severe tornado passed over southeastern part of village; "many buildings unroofed, several literally torn to pieces; trees all along the course of the storm were torn up by the roots and large branches were twisted off and carried long distances; course, SW. to NE. and path of destruction about two miles long and 200 rods wide;" Portsmouth, N. C., 28th, 5:30 p. m., whirlwind struck the beach on south side of inlet forming dense pillar of sand with rotary motion from right to left and moving from SE. to NW., a distance of three miles. It then suddenly receded southeastward to the sea where it disappeared. Diameter of whirl 30 yards.

The observer at Yreka, Cal., reports the following heavy local storms near that place:—July 5th, from 3:30 to 7 p. m., a violent storm passed from S. to N., about 4 miles wide, deluging the country with water; it then seemed to turn and pass to the S., and when about 4 miles east of this place the precipitation was so great that the water seemed to roll along, through, otherwise dry and nearly level gulches, to the depth of 4 or 5 feet, washing everything before it. The storm seemed to extend about 10 miles in length. Shasta river rose two feet in a few minutes; July 16th, heavy storm 15 miles northeast of this place, "cloud bust," moving rocks weighing over one thousand pounds; and on 17th, another heavy fall of water in the same place.

On the 18th a severe thunder-storm passed eastward from northeastern Oregon into Idaho, during the progress of which a destructive "cloud burst" occurred on west Butter (or Bitter) creek, near Pendleton, which will be found noted under *Floods*. The observers at the surrounding Signal Service stations report as follows: Umatilla, Or., "sand-storm set in from the southwest at 3:50 p. m., and for 15 minutes the wind velocity reached 52 miles per hour; rain fell from 3:58 to 4:25 p. m., and several flashes of lightning were observed." Dayton, Wash. Ty., light rain from 3:30 to 5 p. m., "a heavy thunder-storm passed over the mountains about 15 miles south of station at 5 p. m." Pomeroy, Wash. Ty., "sudden heavy wind from 5:30 to 6 p. m." Boise City, Idaho, "light rain from 4:10 to 4:15 p. m., accompanied by zigzag lightning and loud thunder."

Waterspouts.—Key West, 12th, at 6 p. m., a waterspout formed to the southeast of station, in connection with a very heavy thunder-storm then prevailing. Kittyhawk, N. C., 18th, at 8:30 a. m., a waterspout formed over Albemarle Sound, four miles from station. It remained stationary until 8:55 a. m., and no rotary motion could be discerned. During this time two smaller ones partly formed near to the main one, reaching nearly to the clouds, and, after swaying backwards and forwards for a short time, finally disappeared. Portsmouth, N. C., 28th, at 5:15 p. m., three waterspouts formed in Ocracoke Inlet, making a complete column of spray, extending from sea to cloud, and moving slowly from SW. to NE. New Bedford, Mass., 29th, 5 p. m., a waterspout formed in the cove between Sconticut Neck and Mattapoisett Neck. Was at first very regular and straight, and connected with the western edge of a cloud, which was the scene of a thunder shower of moderate extent and force. Diameter 30 to 40 feet, and altitude about 3,000 feet, composed of spray which strongly contrasted with the dark cloud. It moved slowly to the southeast, and the portion midway from cloud to bay advanced faster than either the bottom or top, causing the column to bend forward and to drag the lower portion. It disappeared in about 20 minutes, being apparently drawn upward into the clouds.

Sand-storms.—Visalia, Cal., 25th; Burkes, Ariz., 7th, 10th, 15th, 17th, 24th.

VERIFICATIONS.

Indications.—The detailed comparison of the tri-daily indications for July, with the telegraphic reports for the succeeding twenty-four hours, shows the general percentage of verifications to be 87.2 per cent. The percentages for the four elements are: Weather, 87.0; Direction of the Wind, 77.8; Temperature, 87.3; Barometer, 88.6 per cent. By geographical districts they are: for New England, 81.8; Middle States, 82.6; South Atlantic States, 90.2; Eastern Gulf States, 88.1; Western Gulf States, 91.8; Lower Lake region, 84.5; Upper Lake region, 81.2; Tennessee and the Ohio valley, 89.4; Upper Mississippi valley, 83.0; Lower Missouri valley, 76.8; Northern Pacific coast region, 88.4; Central Pacific coast region, 100.0; Southern Pacific coast region, 96.0. There were 24 omissions to predict out of 3,713, or 0.65 per cent. Of the 3,689 predictions that have been made, 27, or 0.74 per cent. are considered to have entirely failed; 138, or 3.75 per cent. were one-fourth verified; 445, or 12.06 per cent. were one-half verified; 435, or 11.79 per cent. were three-fourths verified; 2,644, or 71.67 per cent., were fully verified, so far as can be ascertained from the tri-daily reports.

Cautionary Signals—68 Cautionary Signals were displayed during the month, of which 56, or 82.4 per cent., were justified by winds of 25 miles per hour or over at, or within a radius of 100 miles of the station. No Off-shore Signals were displayed. The above does not include signals ordered for 49 display stations, where the display is only estimated.

NAVIGATION.

In the table on the right-hand side of chart No. III are given the highest and lowest stages of water in the various rivers, as recorded on the Signal Service river gauges, during July, 1880. From an examination of this table it will be seen that the highest waters were generally recorded during the first half of the month, while in a majority of cases they occurred during the first few days. The lowest readings, with one or two exceptions, occurred during the last days of the month. The only cases in which the water exceeded the danger-point on gauge were at Omaha, Davenport, Keokuk and Portland, Or. At Davenport and Keokuk the highest water occurred on the 1st; this freshet was fully noted in the June *Review*. At Omaha the highest water occurred on the 9th, and submerged the railroad tracks in the vicinity. At Portland, Or., the highest water, in the Willamette river occurred on the 1st and 2nd, and the damage resulting therefrom will be found noted under the head of "Floods."

TEMPERATURE OF WATER.

The temperature of water, as observed in rivers and harbors at Signal Service Stations, with the average depth at which observations were taken, is given in the table on the left hand side of chart No. II. At the following stations observations were not made on the dates indicated: Galveston, 5th to 26th, inclusive; New London, 28th to 31st; and San Francisco, 13th to 31st.

ATMOSPHERIC ELECTRICITY.

Thunder-storms were reported in the following States from one or more stations on almost every day in the month: New York, New Jersey, Pennsylvania, Virginia, North Carolina, Georgia, Florida Louisiana, Texas, Ohio, Michigan, Indiana, Illinois, Iowa, Wisconsin, Nebraska, Kansas, Colorado, and Washington Territory. In the following States they were reported on the dates indicated: *Maine:* 3rd, 7th, 16th, 20th, 26th to 29th. *New Hampshire:* 15th, 22nd, 26th to 28th. *Vermont:* 1st, 2nd, 3rd, 6th, 9th, 10th, 16th, 18th, 20th, 26th to 29th. *Massachusetts:* 6th, 9th, 10th, 15th, 16th, 20th, 26th, 29th and 30th. *Connecticut:* 2nd, 3rd, 6th, 9th, 10th, 11th, 17th, 20th, 26th and 27th. *West Virginia:* 5th, 10th, 19th and 26th. *South Carolina:* 5th, 12th and 17th. *Alabama:* 4th, 14th and 16th. *Mississippi:* 7th, 8th, 10th to 16th. *Tennessee:* 2nd to 5th, 8th 10th, 12th, 15th, 19th and 27th. *Kentucky:* 1st to 6th, 9th, 10th, 14th and 15th. *Arkansas:* 3rd, 9th and 15th. *Indian Territory:* 3rd, 4th, 18th, 19th, 20th and 31st. *Minnesota:* 2nd, 7th, 8th to 13th, 16th, 24th, 28th and 31st. *Dakota:* 1st to 10th, 18th, 20th to 26th. *Montana:* 1st, 4th, 6th, 10th, 11th, 16th, 25th, 26th and 27th. *New Mexico:* 6th, 15th and 16th. *Utah:* 22nd, 27th and 28th. *Nevada:* 17th. *Idaho:* 6th, 18th and 22nd. *Oregon:* 5th and 18th.

Auroras.—Auroral displays were observed north of the 40th parallel from Maine to Montana, on the 1st, 5th, 6th, 11th, 12th, 13th, 14th, 15th, 16th, 17th, 18th, 19th, 26th, 28th, 29th and 31st. The most extensive as well as the most brilliant was the aurora of the 13th, which was observed at many places along the entire northern boundary of the country from Mt. Washington to Helena, Montana, and as far south as New Corydon, Ind. At Pembina, Dak., it appeared brilliant about 8:30 p. m., and continued through the night. At first the whole northern portion of the sky, from about 140° to 300° azimuth, with an altitude of about 90°, was lit up with a pale, white light, differing in nothing from an ordinary twilight except that its upper margin was more distinctly defined. After remaining in this condition about half an hour some appearance of arches and striation began to appear but no distinct arch was formed. The color also changed from a pale white to yellowish green and the quiescent state gave place to one full of motion. The vibrations also partook of the usual dancing motion, still there were but few merry dancers. The quantity of light given off was very great, owing more, however, to the great extent of the light-giving surface than to the intensity of the illumination. On the summit of Mt. Washington an auroral arch was observed from 8 p. m. to midnight, extending from a little W. of N. to NE. In addition to the arch there were several luminous beams through which the stars were shining brightly. Arch and beams were of a white or very pale yellow color. Burlington, Vt., brilliant, a display from 10 p. m, of the 13th to 1:30 p. m. of the 14th. Dark segment not well defined but arch of light was distinct and very brght; the usual bright spots in the extreme WNW. and ENE. were especially brilliant, the streamers after midnight were numerous but did not extend upward very far, the light was a pale emerald green. At New Corydon, Ind., it was visible from 11 p. m. of the 13th to 1 a. m. of the 14th; at midnight, extension 80°, white arch, altitude 12°, a few beams in the eastern part from 12° to 15° altitude and of a greenish hue. The displays on the other days were faint and merit no extended description. The U. S. S. *Jamestown* at Sitka, Alaska Ty., reports on *January* 18th, 1880, at 1 a. m. "A magnificent aurora borealis appeared, stretching in an arch more less regular, at times perfect, from west around to NE. and for two hours presented a grand spectacle. During the display, which is the first that we have had, our compasses were watched and no effect was produced upon them."

OPTICAL PHENOMENA.

Solar Halos were reported in the following districts on the dates indicated: *New England*, 1st to 6th, 10th, 12th, 16th, 19th, 21st, 22nd, 25th; *Middle Atlantic States*, 5th, 12th, 14th, 18th; *South Atlatnic States*, 31st; *Florida*, 6th, 13th, 18th, 19th, 29th; *Gulf States*, 2nd, 7th, 23rd, 24th, 26th, 31st; *Ohio Valley and Tennessee*, 3rd, 5th, 7th, 10th, 14th, 18th, 23rd, 26th, 28th, 31st; *Lake region*, 1st, 2nd, 3rd, 5th, 11th, 12th, 17th, 22nd, 23rd, 25th, 29th, 31st; *Northwest*, 2nd, 3rd, 4th, 5th, 9th, 17th, 19th, 22nd to 26th; *Utah*, 8th, 15th, 16th; *California*, 12th; *Oregon*, 11th.

Lunar Halos were reported in the following districts on the dates indicated: *New England*, 1st, 21st, 23rd, 24th. *Middle States*, 11th to 14th, 16th, 17th, 20th, 21st, 30th, 31st. *South Atlantic States and Florida*, 12th, 14th, 15th, 17th to 22nd, 24th, 29th. *Gulf States*, 11th, 13th, 18th to 21st, 26th. *Ohio valley and Tennesse:* 11th, 12th, 19th, 21st and 31st. *Lake region:* 11th to 14th, 17th, 18th, 19th and 23rd. *Northwest:* 13th to 21st, 26th and 30th. *Indian Territory:* 15th and 16th.

MISCELLANEOUS PHENOMENA.

Zodiacal Light.—Nashville, 6th, 8th, 25th, 29th and 31st; Summit, Col., 30th; Monticello, Ia., 28th; Yates Centre, Kan., 10th, 26th, 27th and 31st; Fall River, Mass., 7th. Mr. Chas. Hassel-

brink, Havana, Cuba, reports June 25th, zodiacal light visible, 8 to 8:30 p. m., axis inclined to south about 45°; 27th to 30th, imperfectly visible. July 26th to 30th, imperfectly visible and apparently located more toward the south.

Polar Bands.—Gardiner, Me., 25th; Clear Creek, Neb., 21st; Freehold, N. J., 12th; Vineland, N. J., 17th and 18th; Wytheville, Va., 2nd, 16th and 26th.

Locusts.—Dayton, Wash. Ty., 23rd, taking wing, no definite line of travel; Winnemucca, Nev.. 3rd, flying southeast in large masses, obscuring the sun; Ft. Douglas, Utah., 5th, in large numbers,

Mirage.—was observed at Duluth on the 13th and at Richmond, Va., on the 15th. In the latter case it occurred about sunset and is described as follows: "the mirage of a steamer, far down the river, was projected on the black background of heavy clouds."

Meteors.—Lansing, Mich., 30th, very brilliant meteor, leaving train visible for 30 seconds. Cincinnati, 10:30 p. m., very brilliant meteor, course southwest, trail visible 10 seconds. Little Rock, Ark., 25th, 9:15 p. m., very brilliant meteor, leaving a train 20° long, lasting about 10 seconds, "bright as moonlight."

Sunsets.—The characteristics of the sky at sunset as indicative of fair or foul weather for the succeeding twenty-four hours have been observed at all Signal Service Stations. Reports from 124 stations show 3,812 observations to have been made, of which 29 were reported doubtful; of the remainder, 3,058 or 80.8 per cent. were followed by the expected weather.

Prairie and Forest Fires.—Summit, Col., 2nd. Near Portland, Or., 16th, 17th, 20th, 24th, 26th. Colorado Springs, Col., 7th and 8th. Eastport, Me., 11th and 14th. In Penobscot and Washington Cos., Me., 20th, fires raging with great fury, causing an immense amount of damage to forests and crops. St. John's, N. B., 16th, fires raging all along the line of the St. John and Maine, and European and North American R. R. Many bridges destroyed and great loss caused to timber and crops.

Earthquakes.—Memphis, Tenn., 13th, between 8:10 and 8:45 p. m., two shocks with interval of about 50 seconds; direction from NNE. to SSW. Low rumbling noise preceded shocks lasting about 10 seconds; motion oscillatory, accompanied by a quivering sensation; windows shook; katydids on trees silenced; furniture rocked and mirrors vibrated. Antrim, N. H., 21st, about 7 p. m., two shocks, with interval of a few seconds. There was a low rumbling sound like a heavy carriage passing by. Houses shook, windows and dishes rattled. These shocks were experienced by several persons living at various places, about two miles from village. Kingston, Jamaica, July 16th, 10.25, p. m., Washington mean-time, slight earthquake, oscillations from N. to S.; lasted about 3 seconds. Ottawa, Canada, 22nd, 2 a. m., "a decided shock, seemed to be going from W. to E., accompanied by a low rumbling noise."

Sun Spots.—The following record of observations, made by Mr. D. P. Todd, Assistant, has been forwarded by Prof. S. Newcomb, U. S. Navy, Superintendent, Nautical Almanac Office, Washington, D. C.:

Date—July, 1880.	No. of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Remarks.
	Groups	Spots.	Groups	Spots.	Groups	Spots.	Groups	Spots	
3rd, 6 p. m...	0	0	0	7	0	0	2	13	Faculæ.
4th, 4 p. m...	1	7	1	4	0	0	2	16	Faculæ.
7th, 10 a. m...	0	20†	0	0	0	0	2	36†	Faculæ. Many of the spots small.
9th, 4 p. m...	0	0	1	10	0	0	1	10	Faculæ.
11th, 5 p. m...	0	0	0	0	0	0	0	0	Faculæ.
12th, 8 a. m	0	0	0	0	0	0	0	0	Faculæ.
16th, 10 a. m...	0	0	0	0	0	0	0	0	Large areas of faculæ.
17th, 10 a. m...	0	0	0	0	0	0	0	0	Large areas of faculæ.
18th, 9 a. m...	1	4	0	0	0	0	1	4	
23rd, 2 p. m...	1	16†	0	0	.....	.....	2	20†	
24th, 2 p. m...	0	0	0	0	0	0	2	20†	Faculæ.
26th, 12 m...	2	12	1	8	2	12	3	24†	Many groups of faculæ.
27th, 12 m...	0	0	0	6	0	0	3	18†	Faculæ.
28th, 5 p. m...	0	0	1	6	0	0	2	12	Many groups of faculæ.
29th, 5 p. m...	0	0	0	0	0	0	2	12	
30th, 5 p. m...	0	0	0	0	0	0	2	6	Faculæ.
31st, 3 p. m...	2	6	0	0	1	3	2	6	

†Approximated

Mr. Wm. Dawson, at Spiceland, Ind., reports: 1st, 2 groups, 15 spots; 2d, 2 groups, 6 spots, one large spot in SW. quadrant, observation poor; 4th, 2 groups, 16 spots, large spot gone, new group of 10 spots S. of centre; 8th, 2 groups, 25 spots, three pretty large spots 1′ from SW. edge, 22 spots 9′ east of 3 former spots; 9th, 2 groups, 17 spots; 10th, 2 groups, 10 spots; 12th, only one small spot nearly S. of centre, bright faculæ at W. edge; 13th and 14th, no spots; 15th, one to the S. very near E. edge; 16th, 1 group, 4 spots; 17th, no spots, air poor; 18th, 2 groups, 18 spots, groups near each other, 8′ from E. edge; 19th, 2 groups, 20 spots; 20th, 2 groups, 35 spots, air poor; 22nd, 3 groups, 40 spots; 23rd, 3 groups, 56 spots; 24th, 3 groups, 27 spots, air poor; 25th, 4 groups, 40 spots, new group at E. edge; 26th, 3 groups, 24 spots, two large spots have each divided into 2 spots; 27th, 2 groups, 26 spots, four spots at W. edge, 22 near E. edge, all

small; 29th, 2 groups, 24 spots, mostly very small, air very good; 30th, 1 group, 12 spots; 31st, 2 groups, 10 spots, a long narrow spot very close to E. edge, probably a very large one.

Mr. H. D. Gowey, at North Lewisburg, O., observed spots on the 7th, and from the 21st to the 26th, inclusive. They disappeared by solar rotation.

NOTES AND EXTRACTS.

[American Journal of Science, April, 1880, page 300.]

Observations on the Height of Land and Sea Breezes, taken at Coney Island, by O. T. Sherman.— The following observations were taken at Coney Island with the captive balloons of the American Aeronautic Society, S. A. King, aeronaut in charge. Captain Howgate furnished the observer.

With the exception of the hotels, no height rises to interrupt the flow of the wind. We might expect, therefore, to find the sea breeze and its counter current undisturbed. The standard thermometer employed was of the Signal Service pattern, made by James Green, and carefully tested by the observer. The aneroid barometers were kept compared with a standard mercurial instrument at the surface. The anememeter, of Robinson's pattern, furnished by James Green, was used to measure the velocity of the wind at the top of the ascent, and also at the bottom. In the other cases, the forces were estimated.

The record was commenced as the balloon left the earth and continued without interruption till the balloon attained its highest point. At the top, the velocity of the wind was recorded by a "five minute" observation. On the descent the same plan was followed.

From the barometric readings, reduced to the mercurial standard, the heights were reduced by Loomis' table as given by Guyot. A comparison of these heights with those deduced from the length of the rope in use showed a close agreement. The thermometric readings reduced to the standard thermometer were then plotted in a curve whose ordinates were heights, and the abscissas, the degrees of the thermometric scale. The ascent and descent giving somewhat discordant values, a free hand curve was drawn between them. The positions of the curve are given in the annexed table. The force of the wind was treated in a like manner. The observed directions were then plotted opposite the heights. When discordant at one height, they were referred to that one of the sixteen equal divisions of the compass which lay between them. The whole was then referred to the mean of the times of leaving and regaining the earth, an interval of about fifteen minutes. New York time was employed. The results are given in the following table:

Table showing the direction and force of wind and the temperature at heights from 0 to 1200 feet above the beach at Coney Island, New York.

The first line in the table gives the heights above the ground in feet. The upper numbers indicate the temperature in Fahrenheit degrees. The lower the direction and the velocity of the wind. —— indicates no record of direction, or rather a direction between two neighboring directions.

Day.	Hr.	0	100	200	300	400	500	600	700	800	900	1000	1100	1200
1879.	h m	78.5	76	74.8	74.0	73.5	73.3	73.3						
July 31	10 15	NE. 3	— 2.3	N. 2	— 2.1	NNW. 2.3	— 2.4	NW. 3						
		79.0	77.2	77.0	77.2	77.7	78.2							
" 31	2 46	SW. 2.8	S. 2.6	S. 2.0	S. 1.8	— 1.3	Calm.			NW *				
		74.0	73.4	73.5	74.0	74.2	75.0							
" 31	7 26	SSW. 2.8	— 2.8	S. 3.0	— 3.0	— 2.8	SSE. 2.2							
		77.0	76.6	75.2	74.3	74.2	74.2							
Aug. 1	9 46	SSW. 3	— 3	SW. 4	SW. 5.6	SW. 7	SW. 7.5							
		82.0	77.2	76.0	75.2	74.8	74.4							
" 1	10 54	SSW. 5	— 5	SSW. 5.5	— 6.0	— 6.5	SSW. 6.5							
		76.8	75.0	75.2	75.8	76.0								
" 2	9 0	SW. 3	— 6.3	WSW. 7.0	W. 6.8	W. 6.5								
		84.0	84.2	84.6	85.2	85.6	86.0	86.2	87.0					
" 2	1 55	SSE. 9.0	SSE. 7	S. 5.0	S. 4.5	——	SSW. 5.0	— 4.5	SW. 4.5					
		70.5	68.2	67.6	67.3	67.0	67.0	66.4	66.2	66.0	65.6	65.3	65.0	64.7
" 10	1 19	NNE. 2.0	— 5.0	— 5.4	— 5.4	N. 6.0	— 7.5	— 8.7	— 8.0	— 6.0	— 4.5	— 5.0	NNW. 5.2	NNW. 5.7
		73.3	72.7	72.2	71.8	70.8	69.5	68.8	68.0	68.0	68.0	67.6	67.2	66.8
" 10	3 10	NW. .8	— 5.3	— 7.5	— 9.0	— 11.0	— 13.5	— 16.5	— 16.5	—14.0	— 12.0	— 11.5	— 11.7	NNW. 12.0
		72.8	71.0	70.3	69.8	69.2	68.5	68.0	67.5	67.0	66.8	66.4	66.2	66.0
" 10	5 42	NW. .3	NW. 4	— 4	— 3	— 3	— 3.8	NW. 4	— 4	NW. 4	— 4.0	— 4.0	— 4.0	NW. 3.8
		79.0	74.8	73.9	73.0	72.4	71.7	71.2	70.6	70.6	70.5	70.4	70.0	
" 11	2 10	SSE. .8	SSE. 8.3	— 9.3	S. 8.2	S. 7.0	SSW. 6	— 5.5	SSW. 5.2	— 5.0	— 5.2	— 7.5	SSW. 10.5	
		74.5	73.2	72.7	72.7	72.7	72.7	72.0	72.0	72.0	72.0	71.5	71.3	71.1
" 12	10 50	S. 5	— 5	— 4.5	SW. 4.5	SW. 4.5	SW. 4.5	WSW. 3.6	WSW. 4.0	W. 4.5	— 5.0	WNW. 6	— 6	NW. 6.3
		78.0	71.5	71.3	70.6	70.0	69.6	69.5	69.2	69.2	69 2	68.7	68.2	68.3
" 13	11 50	SSE. 7.5	SSE. 8.4	SSE. 8.4	S. 8.4	SSW. 7.6	— 5.0	SW. 3.8	WSW. 4.2	W. 4.7	WNW. 5.8	WNW. 6.8	WNW. 10.5	WNW. 12
		80.3	80.0	79.2	78.7	78.2	77.8	77.4	77.8					
" 14	1 42	SSE. 7.2	— 4	— 4.5	S. 7.5	SW. 9.8	SW. 11	— 11.5	W. 12					

* Shown by a toy balloon as compared with the captive.

A slight inspection of the return rates of change shows that the return current has influenced the temperature of the air around it to a noticeable extent.

We may consider the observed wind as composed of the wind produced by a great storm in progress, and the sea or land breeze. The sea breeze blows perpendicular to the coast, or about southeast. To obtain the storm wind, I examined the 7:35 A. M. maps of the Signal Service, but since the observations were taken almost directly under areas of maximum pressure, the examination gave no useful results. I therefore adopted a method based upon the following considerations. Of all those directions and velocities which combined with the direction of the sea breeze can produce

the resultant, the storm breeze is that which remains when the sea breeze vanishes; the fact that the sea breeze vanishes is shown by the other component remaining undisturbed. For example, on August 13, the observed wind was SSE., velocity 7.5 miles. This might be produced either by S. 4.5, SE.; SSW., 4, SE., SW., 3, SE., etc., but of these SW., 3 most nearly satisfies the condition that it shall be observed by itself. The surface breeze therefore ends at about 650 feet from the surface of the sea, while above 700 feet a current from the land evidently deflects the breeze toward the northwest. Proceeding with each of the other cases in the same way a mean may be taken. In this manner we have drawn up the following table. The values, though necessarily approximate, gain much from our inability to launch the ballon save on calm days. The sign < implies that the given value is probably too high.

Day.	Hour.	Surface breeze ends.	Return breeze begins.	Return breeze ends.
1879.	h. m.			
July 31	10 15 A. M.	<175 feet.	<400 feet.	
	2 46 P. M.	<500 feet.	About 750.	
	7 26 P. M.	<375 feet.	<400 feet.	
August 1	9 46 A. M.	200? feet.	<308? feet.	
	10 54 A. M.	Above.	the highest	point reached.
2	9 0 A. M.	<200 feet.	<250 feet.	
	1 55 P. M.	<200 feet.	<300 feet.	
10	1 19 P. M.	<400 feet.	<500 feet.	< 900 feet.
	3 10 P. M.	<500 feet.	500 feet.	<1100 feet.
	5 42 P. M.	None.	None.	
11	2 10 P. M.	<825 feet.	<900 feet.	
12	10 50 A. M.	<600 feet.	<800 feet.	
13	11 50 A. M.	<650 feet.	<700 feet.	1050 feet.
14	1 42 P. M.	<300 feet.	<400 feet.	

It becomes evident that both current and counter current are low in the atmosphere. They will perhaps serve to explain a fact often noticed, that though we could plainly see the steam from the locomotives as they whistled, yet could hear no sound though nearly above the track.

[Popular Science Monthly, July, 1880, page 421.]

Efficiency of Lightning-Conductors.—Direct evidence as to the efficiency of lightning-conductors is afforded in a government report from Schleswig-Holstein, which is referred to in a recent work on the subject by Mr. Richard Anderson. Thunder-storms are said to be more numerous in Schleswig-Holstein than in any other part of central or northern Europe, and the danger from lightning is correspondingly increased. The attention of the government insurance-office was called to the fact that, in four out of 552 cases of claims on account of damage from lightning, arising in eight years, conductors of approved design had been in use, and an expert, Dr. Holtz, of Greifswald, was appointed to inquire into the causes of failure. He found that, in every case where a building provided with a conductor had been struck by lightning, the conductor was not in an efficient state. Sometimes the point of the rod was needlessly ornamented with gilding, while the underground connection with the earth, the very element of safety, was neglected. In the absence of a proper ground connection, the lightning-rod, instead of being a protection, may prove the means of attracting the discharge into the building. A measure for the periodical testing of conductors is suggested, for the detection of defective constructions, interruptions of conductivity by rusting or displacement, or of other faults that may arise from time to time.

[Science, July 3, 1880, page 11.]

The Telegraph and Earthquakes.—A recent letter from Mr. W. A. Goodyear, now director of the governmental mining and geological survey of San Salvador, states that more than 600 shocks of earthquakes were felt there during the last ten days of 1879. They were heaviest about Lake Ilopango, where a shock occurred on the 23rd of December, which broke the telegraph wire asunder and "made the ground on which we stood a perfect network of cracks, opened new springs of water, increased the rivulets in the vicinity to ten times their usual volume, muddied the waters of the lake in many places, and rolled hundreds of thousands of tons of rocks down the steep hills in the form of land-slides." As a sequel to these earthquakes, came the irruption of a volcano in the middle of Lake Ilopango on the night of January 20th to 21st. The volcanic island resulting now measures over five acres in extent, and shoots up a column of steam into the air over 1000 feet in height. This is the first instance we have heard of earthquakes interrupting land telegraph lines, though there are cases on record of their interrupting cables.

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

Albert J. Myer

Brigadier General, Chief Signal Officer, U. S. A.

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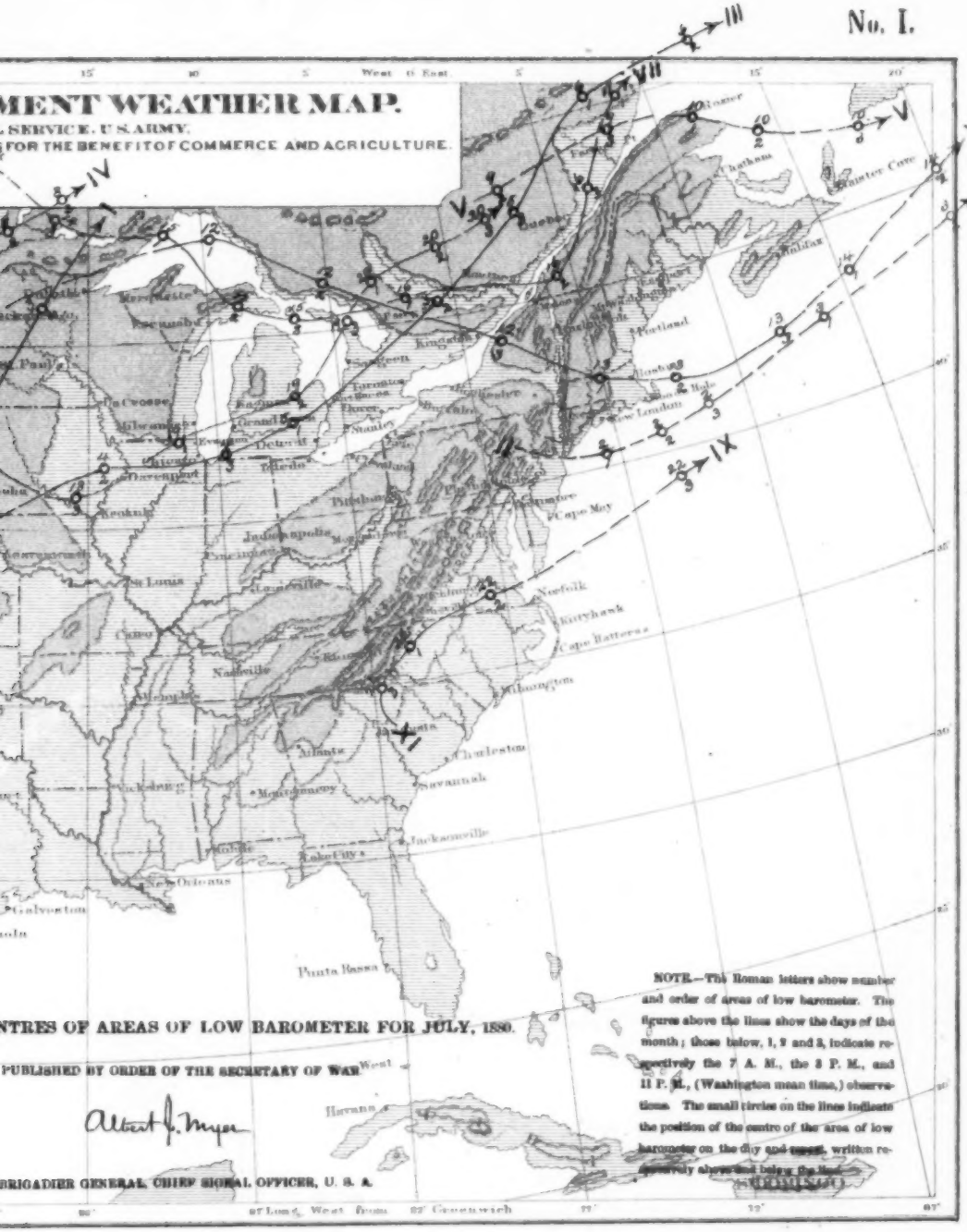
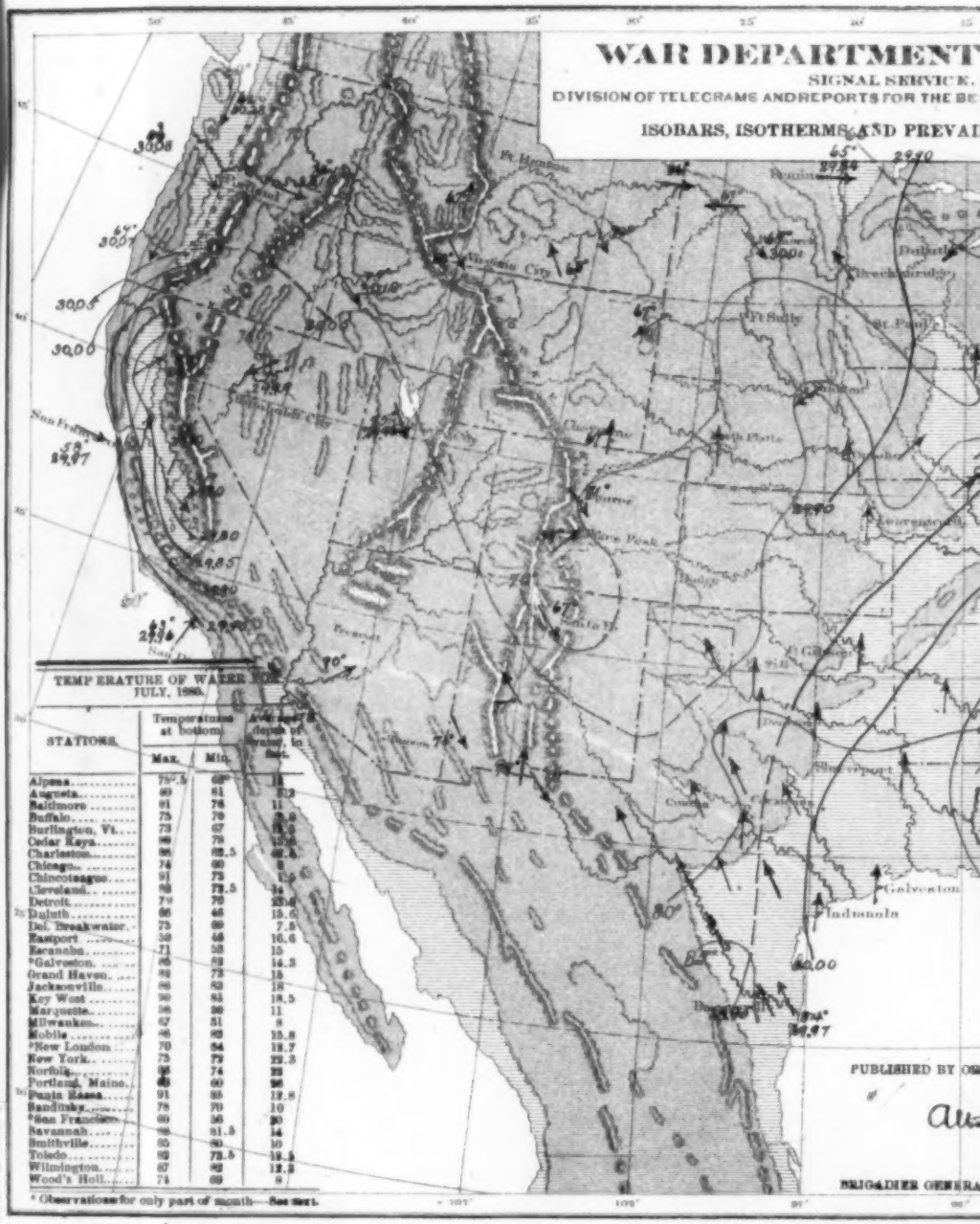
AVERAGE PROGRESS OF AREAS OF LOW BAROMETER EAST OF THE 100TH MERIDIAN.

No.	Velocity.
I.	20 miles per hour.
II.	— do.
III.	30 do.
IV.	— do.
V.	— do.
VI.	25 do.
VII.	28 do.
VIII.	25 do.
IX.	16 do.
X.	— do.
XI.	— do.
XII.	— do.

No. I.


MENT WEATHER MAP.
L SERVICE, U.S.ARMY.
FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.
NOTE.—The Roman letters show number and order of areas of low barometer. The figures above the lines show the days of the month; those below, 1, 2 and 3, indicate respectively the 7 A. M., the 3 P. M., and 11 P. M., (Washington mean time,) observations. The small circles on the lines indicate the position of the centre of the area of low barometer on the day and hour, written respectively above and below the line.
NTRES OF AREAS OF LOW BAROMETER FOR JULY, 1880.
PUBLISHED BY ORDER OF THE SECRETARY OF WAR
Albert J. Myer
BRIGADIER GENERAL, CHIEF SIGNAL OFFICER, U. S. A.

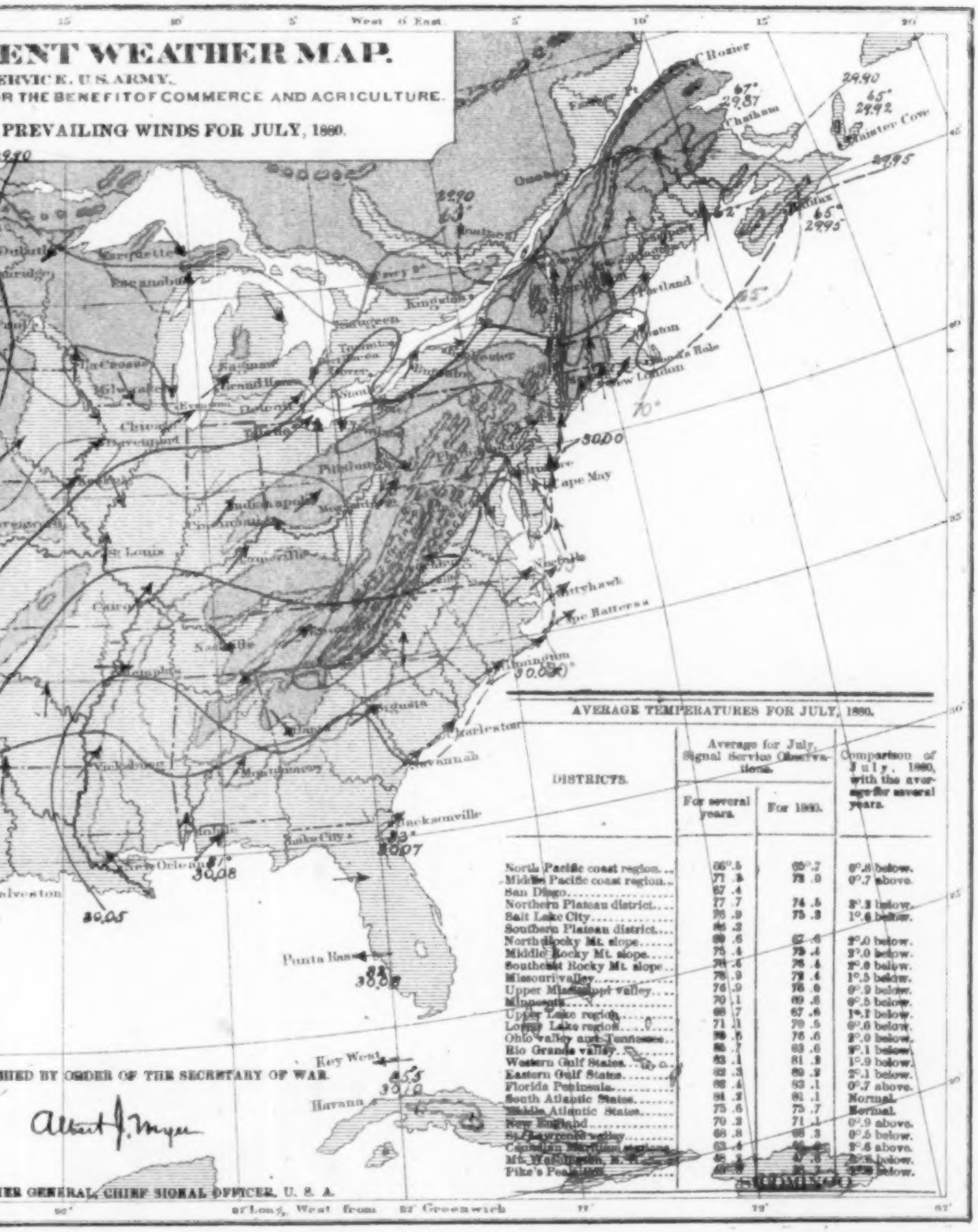


TEMPERATURE OF WATER FOR JULY, 1886.

STATIONS.	Temperature at bottom.		Average depth of water, in fms.
	Max.	Min.	
Alpena	75°.5	68°	15
Augusta	69	61	22.2
Baltimore	81	76	11
Buffalo	75	70	6.9
Burlington, Vt.	73	67	15.3
Cedar Keys	86	78	13.6
Charleston	86	82.5	42.5
Chicago	74	69	8
Chincoteague	81	79	10.5
Cleveland	80	73.5	14
Detroit	79	70	23.6
Duluth	66	46	15.6
Del. Breakwater	75	69	7.5
Eastport	59	46	16.6
Escanaba	71	53	15
*Galveston	85	82	14.3
Grand Haven	81	73	15
Jacksonville	86	82	18
Key West	90	84	18.5
Marquette	68	59	11
Milwaukee	67	51	8
Mobile	86	82	15.8
*New London	70	64	18.7
New York	75	73	22.3
Norfolk	86	74	22
Portland, Maine	65	60	26
Punta Rassa	91	85	12.8
Sandusky	78	70	10
*San Francisco	60	56	20
Savannah	86	81.5	14
Smithville	85	80	10
Toledo	82	73.5	12.5
Wilmington	87	82	12.3
Wood's Holl	74	69	8

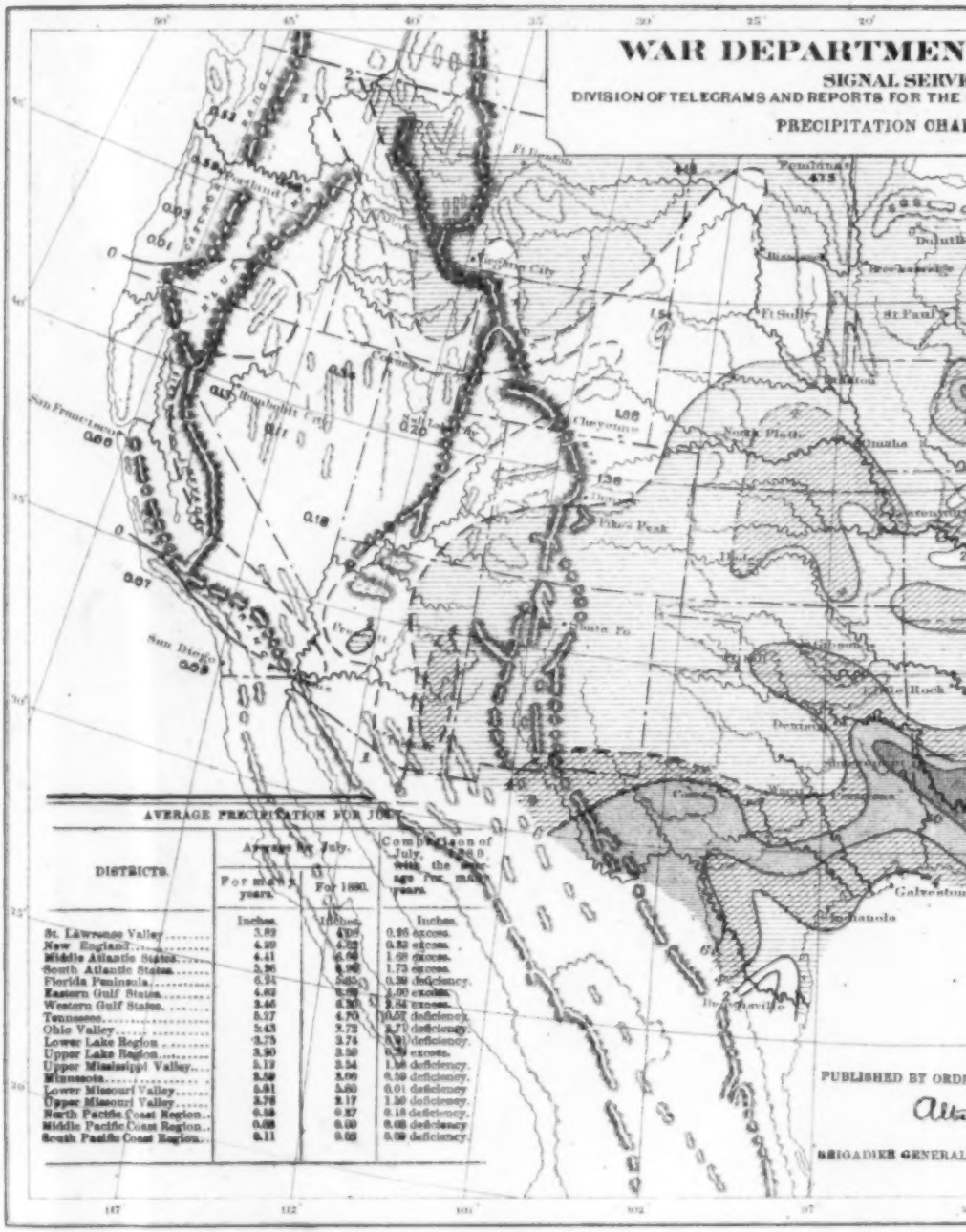
* Observations for only part of month—See Sect.

No. II.



AVERAGE TEMPERATURES FOR JULY, 1880.

DISTRICTS.	Average for July, Signal Service Observations. For several years.	For 1880.	Comparison of July, 1880, with the average for several years.
North Pacific coast region	66°.5	65°.7	0°.8 below.
Middle Pacific coast region	71 .3	72 .0	0°.7 above.
San Diego	67 .4		
Northern Plateau district	77 .7	74 .5	3°.2 below.
Salt Lake City	76 .9	75 .3	1°.6 below.
Southern Plateau district	86 .2		
North Rocky Mt. slope	69 .6	67 .6	2°.0 below.
Middle Rocky Mt. slope	75 .4	73 .4	2°.0 below.
Southeast Rocky Mt. slope	[illegible] .4	76 .4	3°.0 below.
Missouri valley	78 .9	77 .4	1°.5 below.
Upper Mississippi valley	76 .9	76 .0	0°.9 below.
Minnesota	70 .1	69 .6	0°.5 below.
Upper Lake region	68 .7	67 .6	1°.1 below.
Lower Lake region	71 .1	70 .5	0°.6 below.
Ohio valley and Tennessee	78 .6	76 .6	2°.0 below.
Rio Grande valley	85 .7	83 .6	2°.1 below.
Western Gulf States	83 .1	81 .2	1°.9 below.
Eastern Gulf States	82 .3	80 .2	2°.1 below.
Florida Peninsula	82 .4	83 .1	0°.7 above.
South Atlantic States	81 .1	81 .1	Normal.
Middle Atlantic States	75 .6	75 .7	Normal.
New England	70 .2	71 .1	0°.9 above.
St. Lawrence valley	68 .8	68 .3	0°.5 below.
Canadian Maritime stations	63 .4	[illegible]	2°.6 above.
Mt. Washington, N. H.	[illegible]	[illegible]	[illegible] below.
Pike's Peak	[illegible]	[illegible]	[illegible] below.



AVERAGE PRECIPITATION FOR JULY.

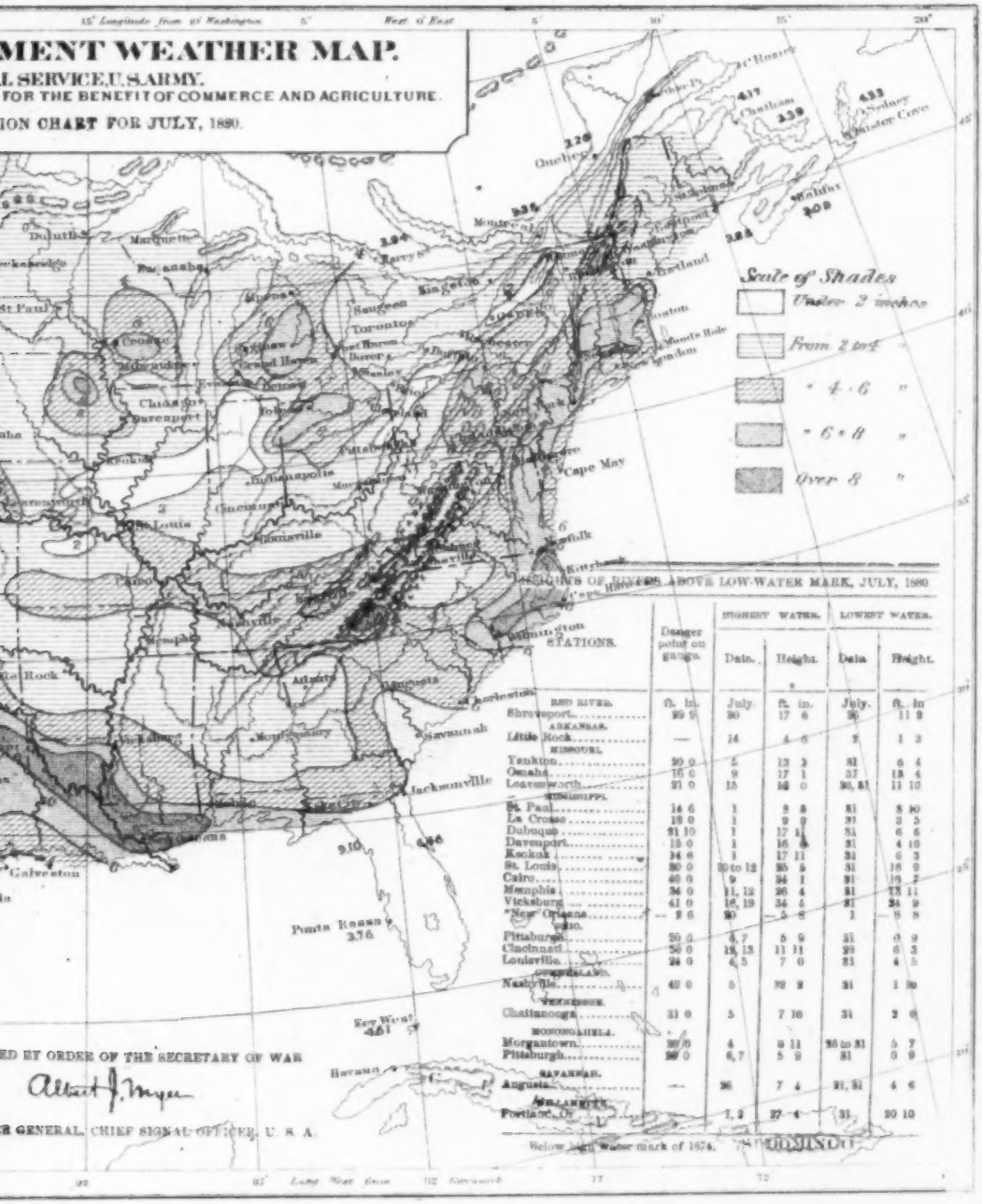
DISTRICTS.	Average for July. For many years.	Average for July. For 1880.	Comparison of July, 1880, with the average for many years.
	Inches.	Inches.	Inches.
St. Lawrence Valley	3.89	4.05	0.16 excess.
New England	4.39	4.72	0.33 excess.
Middle Atlantic States	4.41	6.09	1.68 excess.
South Atlantic States	5.36	6.09	1.73 excess.
Florida Peninsula	6.24	5.85	0.39 deficiency.
Eastern Gulf States	4.62	6.62	2.00 excess.
Western Gulf States	3.46	6.20	2.54 excess.
Tennessee	5.17	4.70	0.47 deficiency.
Ohio Valley	3.43	3.72	0.29 deficiency.
Lower Lake Region	3.75	3.74	0.01 deficiency.
Upper Lake Region	3.90	3.50	0.40 excess.
Upper Mississippi Valley	3.12	3.54	1.58 deficiency.
Minnesota	3.59	3.09	0.50 deficiency.
Lower Missouri Valley	5.81	5.80	0.01 deficiency.
Upper Missouri Valley	3.76	2.17	1.59 deficiency.
North Pacific Coast Region	0.55	0.37	0.18 deficiency.
Middle Pacific Coast Region	0.08	0.00	0.08 deficiency.
South Pacific Coast Region	0.11	0.02	0.09 deficiency.

MENT WEATHER MAP.

L SERVICE, U.S. ARMY.

FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

ION CHART FOR JULY, 1880.



HEIGHTS OF RIVERS ABOVE LOW-WATER MARK, JULY, 1880

STATIONS.	Danger point on gauge.	HIGHEST WATER. Date.	Height.	LOWEST WATER. Date.	Height.
	ft. in.	July.	ft. in.	July.	ft. in.
RED RIVER.					
Shreveport	29 0	30	17 6	30	11 9
ARKANSAS.					
Little Rock	—	14	4 6	2	1 3
MISSOURI.					
Yankton	20 0	5	13 3	31	6 4
Omaha	16 0	9	17 1	27	13 6
Leavenworth	21 0	15	16 0	30, 31	11 10
MISSISSIPPI.					
St. Paul	14 6	1	8 8	31	3 10
La Crosse	18 0	1	9 9	31	3 5
Dubuque	21 10	1	17 11	31	6 6
Davenport	18 0	1	16 4	31	4 10
Keokuk	24 6	1	17 11	31	6 3
St. Louis	30 0	10 to 12	25 5	31	16 0
Cairo	40 0	9	34 1	31	19 2
Memphis	34 0	11, 12	26 4	31	13 11
Vicksburg	41 0	18, 19	34 4	31	24 9
New Orleans	2 6	30	5 8	1	8 8
OHIO.					
Pittsburgh	35 0	4, 7	5 9	31	0 9
Cincinnati	50 0	12, 13	11 11	29	6 3
Louisville	24 0	4, 5	7 0	31	4 5
CUMBERLAND.					
Nashville	40 0	5	22 2	31	1 10
TENNESSEE.					
Chattanooga	33 0	5	7 10	31	2 6
MONONGAHELA.					
Morgantown	20 0	4	9 11	16 to 31	5 7
Pittsburgh	30 0	6, 7	5 9	31	0 9
SAVANNAH.					
Augusta	—	26	7 4	31, 31	4 6
WILLAMETTE.					
Portland, Or.		1, 2	27 6	31	20 10

Below high water mark of 1876.

ED BY ORDER OF THE SECRETARY OF WAR

Albert J. Myer

R GENERAL, CHIEF SIGNAL OFFICER, U. S. A.

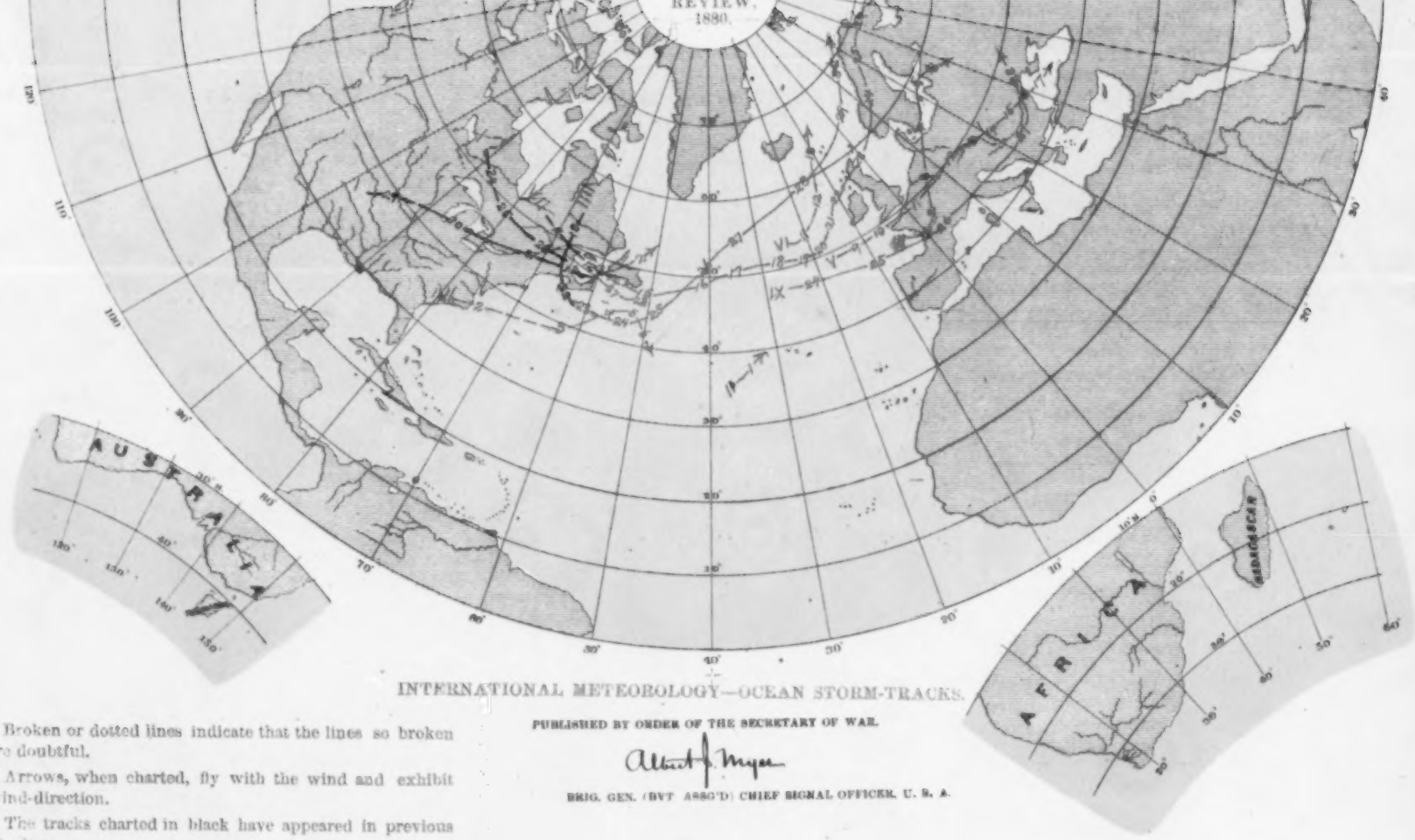
WINDS ACCOMPANYING THE ATLANTIC STORMS.

No.	American Coast. Date.	Direction.	Miles per Hour.	Metres per Second.	European Coast. Date.	Direction.	Miles per Hour.	Metres per Second.
V.	June 12.	W'ly.	15	6.7	June [illegible]	SE	*25 to 35	11.2 to 15.6
VIII	21, 22.	NW.	25 to 40	11.2 to 17.9	[illegible]	S'ly.	*30	[illegible]

Estimated from Beaufort scale

INDEX TO STORM-TRACKS

No. I. from May 29 to June 3, 1880
II. on June 1, 1880.
III. from June 1 to June 6, 1880.
IV. from June 3 to June 6, 1880.
V. from June 9 to June 17, 1880.
VI. from June 11 to June 13, 1880.
VII. from June 11 to June 18, 1880.
VIII. from June 21 to June 30, 1880.
IX. from June 24 to June 28, 1880.
X. from June 26 to June 28, 1880.



INTERNATIONAL METEOROLOGY—OCEAN STORM-TRACKS.

Broken or dotted lines indicate that the lines so broken are doubtful.

Arrows, when charted, fly with the wind and exhibit wind-direction.

The tracks charted in black have appeared in previous *Reviews*.

The tracks charted in red have been made from data collected since preceding *Review*.

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

Albert J. Myer

BRIG. GEN. (BVT ASSO'D) CHIEF SIGNAL OFFICER, U. S. A.

Office of the Chief Signal Officer,

UNITED STATES ARMY.

Charted from Actual Observations taken Simultaneously, Series commencing September, 1877.

No. V.

PREVAILING WINDS.

Arrows show the direction of, and fly with, the wind.
Force is shown as follows:

Symbols.	Force.	Velocity.	
		Miles per hour.	Metres per second.
→	1, 2	0 to 9	0 to 4.0
↣	3, 4	9.1 to 22.5	4.1 to 10.1
↠	5, 6	22.6 to 40.5	10.1 to 18.1
⇉	7, 8	40.6 to 67.5	18.1 to 30.2
⇉	9, 10	67.6 up.	30.2 & over.

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Albert J. Myer

BRIG. GEN. (BVT ASSG'D) CHIEF SIGNAL OFFICER, U. S. A.

ISOBARS AND ISOTHERMS.

Isobars in *blue*; detached barometer means in English inches.

Isotherms in *red*; detached temperature means in degrees Fahrenheit.

Broken lines are doubtful.

INTERNATIONAL MONTHLY CHART.

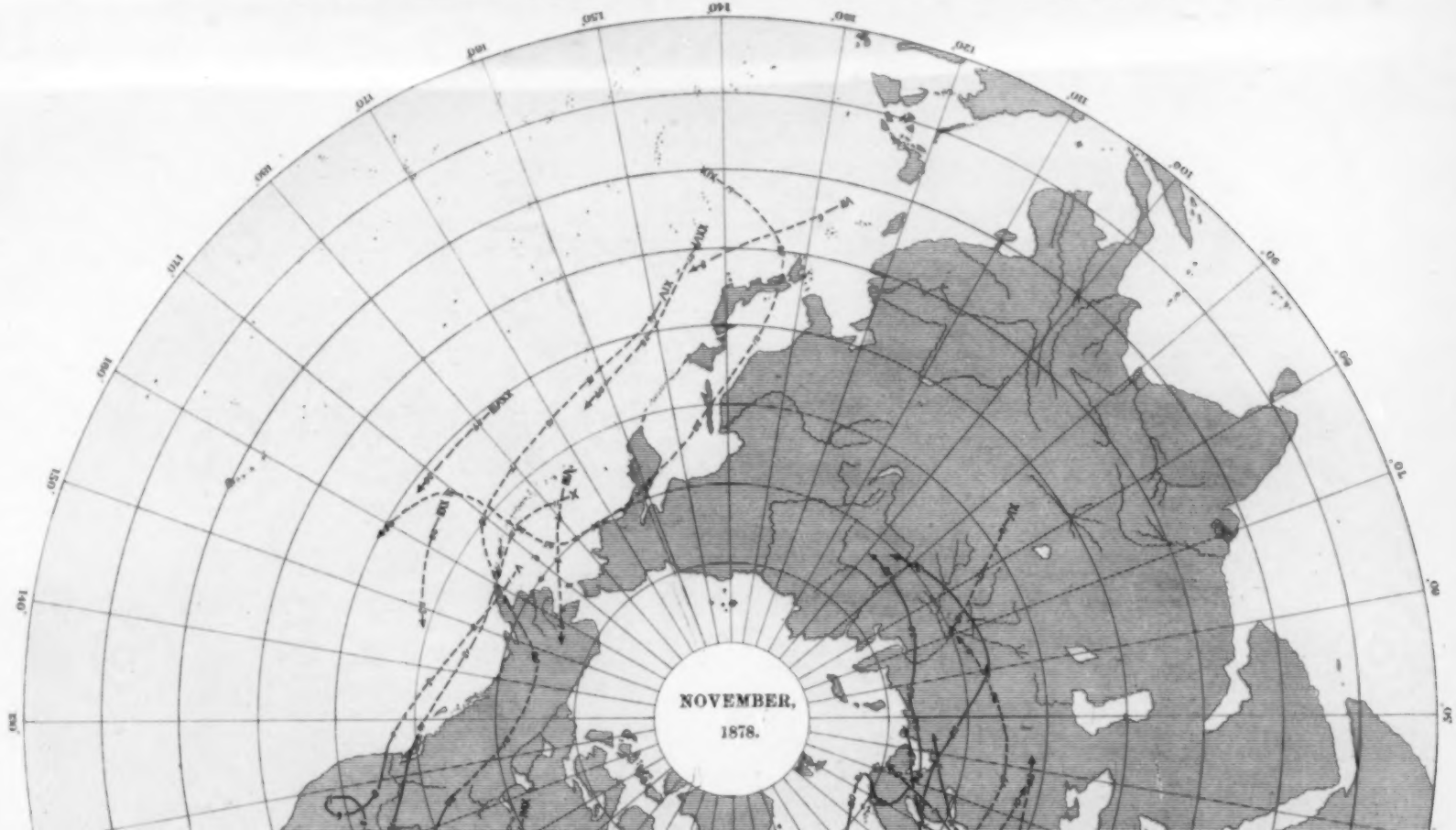
Showing mean pressure, mean temperature, mean force and prevailing direction of winds at 7:35 A. M., Washington mean time, for the month of November, 1878, based on the daily charts of the International Bulletin.

Office of the Chief Signal Officer,

UNITED STATES ARMY.

Charted from Actual Observations taken Simultaneously, Series commencing October, 1877.

No. VI.



Storm-tracks in *Black*. The Arabic numerals show location of the centres of Low Barometer, at 7:35 A. M., Washington mean time, of that date.

Broken or dotted lines, are doubtful.

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Albert J. Myer

BRIG. GEN. (BVT. ASSG'D) CHIEF SIGNAL OFFICER, U. S. A.

INTERNATIONAL CHART.

Showing Tracks of Centres of Low Barometer for November, 1878.